Surveying and Mapping

September 1959

Quarterly Journal
AMERICAN CONGRESS ON SURVEYING AND MAPPING

New Electronic Devices and Special Maps Cut Highway Mapping Costs, Speed Surveys

Throughout the United States, new highway programs are being completed faster . . . and at lower costs. One big reason *why* is the increasing use of aerial surveys coupled with lightning-like electronic computations during highway planning. Aero Service Corp., Philadelphia—a pioneer in the field—is busy now in 12 states from Alabama to California furnishing engineering services and data for preliminary and final location studies.

One survey near Huntingdon, W. Va., for J. Stephen Watkins, Consulting Engineers of Lexington, Ky., and Charleston, W. Va., is an interesting example. Fourteen miles of Interstate Route I-64—a four-lane divided highway—were to be hacked out of the foothills of the Alleghenies. Phase 1 of Aero's work included aerial photography at two scales—one for compilation of a 5 ft. contour map at 1″ = 200 ft. for location studies, and one for a 2 ft. map at 1″ = 50 ft. for photogrammetric cross-sections. Phase 2 was field surveys to establish vertical and horizontal control data for the maps and cross-sections. This basic control was monumented for recovery and use during final staking and layout.

To save time and money, the penciled topographic sheets were not inked. Instead, photo copies were made and auto-positives delivered. These covered a swath ½ mile wide at a scale of 1″ = 200 ft., showing 5 ft. contours and all cultural details.

J. Stephen Watkins engineers studied the maps and refined the route location. Then Aero compiled 1″ = 50 ft. maps of a strip 500 ft. wide centered on the final route location. Roads, railroads, power and transmission lines, fences, bridges, culverts, retaining walls and woods lines were shown. As the design of interchange sites and grade separations were finalized, Aero added 2 ft. contours in these areas, and delivered maps at both 1″ = 50 ft. and 1″ = 30 ft.

After the maps showing the proposed centerline were received from the consultant, Aero took cross-sections by photogrammetric methods at 50 ft. intervals and at significant breaks in the terrain. Readings were made to a width of 300 ft., with wider sections as required by heavy cut or fill.

These cross-section data were punched in IBM Cards and verified. Aero fed these cards as input to a Data-plotter,

Air photo shows proposed highway center line. Topographic map of the same West Virginia area shows 2 ft. contours and portion of cross section locations.

which plotted cross-sections on Federal Aid cross-section sheets. Scale was 1″ = 10 ft., horizontally and vertically. Conferences between Aero's and client's engineers established the desirability of a smaller scale, and the sections for the latter portions were plotted at 1″ = 20 ft.

For the earthwork volume computations, Aero prepared the data so that it could be processed in Watkins' new Bendix G-15 computer. In other cases, Aero could process a duplicate set of punch cards in the IBM 650 Computer. Then Aero would deliver a tabulation showing cut, fill and net volume at each station, as well as accumulated cut, fill and net, plus slope stake offsets. Accuracy of all such computed volumes are checked with input data. Net result: substantial savings in time, manpower, money.

In California, Aero provided the State Highway Department with a Photo Contour Map. It will be used as a planning tool for preliminary studies. Photo Contour Maps give highway planners a more complete picture of route possibilities.

Aero's engineers will be glad to provide more information about its capabilities and to discuss photogrammetric engineering solutions of highway survey problems. Aero's fully integrated mapping services include topographic maps, photo-mosaics, and preliminary and detailed studies of engineering soils and geology for highway design (photo interpretation, drilling, sampling, testing and engineering reports). Aero Service's headquarters are at 210 E. Courtland St., Philadelphia 20, Pa.

SURVEYING AND MAPPING

Editor-in-Chief
Howard S. Rappleye

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The Surveyor's Notebook

Reporting on Unusual Surveying Problems and Their Solutions

Notekeeper: W. & L. E. Gurley, America's Oldest Engineering Instrument Maker

Salted footprints, decades old, led him to his goal

Since 1904 Andrew Nelson, dean of federal surveyors, has surveyed some seven million acres. Laid end to end these linear surveys would girdle the earth—and then some.

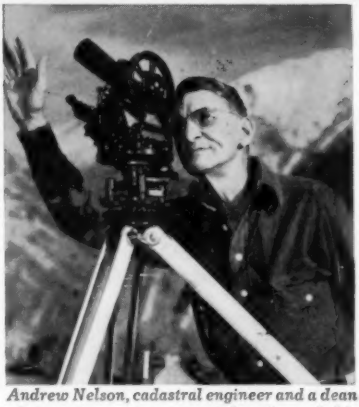
In the Great Salt Lake Desert area in 1926, Nelson had to tie his survey into the area to the north, surveyed over a quarter century earlier. *His problem:* how to find posts planted in 1870?

For Nelson, wise in desert procedures, this was no great problem. Scouting northward he found the 26-year-old footprints of a five-man crew, still preserved in salt. Following them to the lost post markers, he left his own, perhaps for future surveyors to find and follow decades hence.

Nelson has several times walked 45 miles in one day. He has used snowshoes, skis, toboggans, canoes, horses—and riding 60 miles in a day, muleback, is all in a day's work for him.

As a follower of the surveyor's "straight and narrow" for half a century, he has worked in heat that burst thermometers, and cold bitter enough to quickfreeze human lungs. During his wilderness work he has feared only one animal and claims a speed record for the mile on snowshoes fleeing from the threat of a pack of wolves.

Surveyors often come upon dramatic evidence of past history. Nelson's most interesting find was three wagons, abandoned by the ill-fated Donner Expedition in 1846. In the old wagon traces, the bones of oxen lay as they had been abandoned eighty years earlier—fully preserved in salt. Wheel tracks still remain for anyone to see.



Andrew Nelson, cadastral engineer and a dean of American surveyors, sights through his Gurley Telescopic Solar Transit.

As he is one of the last of a vanishing fraternity of surveyors, Nelson's views on instruments are valuable. He says: "The Gurley Telescopic Solar Transit can save countless hours when re-running a misclosure. It is invaluable for checking on precise traverses. For large-scale precision surveying, *nothing equals a Gurley.*"

"Tips from The Surveyor's Notebook": *We have collected the most helpful, most discussed pages from Series One and Two of "The Surveyor's Notebook" in one 20-page book. These valuable field suggestions will help you use your own instruments with greater success. Write for your free copy.*

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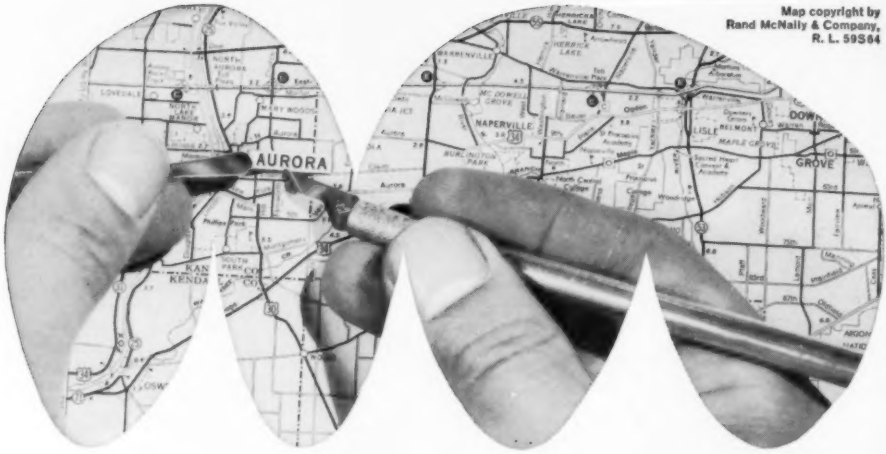

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Precise Survey of the 25 BEV Synchrotron at Brookhaven National Laboratory

By CAPTAIN O. S. READING

BROOKHAVEN NATIONAL LABORATORY, UPTON, L. I., N. Y.

THE REMARKABLE development of research in the physical sciences during the past decade has resulted in an increasing demand for high precision in surveys. Many large aircraft, speed test ranges, and large machines are being built which require measurements of higher precision than is generally specified for first order geodetic surveying. One of these projects is the 25 billion electron volt alternating gradient proton synchrotron now being built at the Brookhaven National Laboratory in the United States.

SPECIFICATIONS FOR THE SURVEY

This machine (Figure 1) requires the location of some 240 magnets around a circle about ½ mile (800 meters) in circumference within one tenth millimeter (0.004 inch) of their specified positions in relation to each other. However, two diameters of the circle may vary as much as ⅜ inch (1 centimeter) without handicap to the machine, providing the change in the diameter is very gradual and not so placed as to set up oscillations in the ninth harmonic as the particles are accelerated to some 350,000 passages a second around the circle. This paper describes the modifications of geodetic survey instruments and methods, including some special devices, adopted to attain this specified precision, as of 12 March 1959.

PLAN OF SURVEY AND PRELIMINARY RESULTS

The machine is being built in a tunnel in order to provide shielding from high energy radiation when the machine is in operation. The tunnel is approximately 18 feet wide. This width permitted the establishment of 24 equally spaced control survey stations around the circumference with each station intervisible with the first

Presented at the 19th Annual Meeting of the American Congress on Surveying and Mapping, Washington, D.C., March 11–13, 1959.

FIGURE 1.

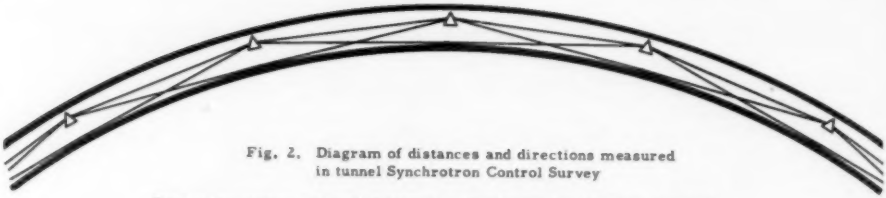

Fig. 2. Diagram of distances and directions measured in tunnel Synchrotron Control Survey

Root mean square error of distances - 17 microns for 33 meter interval
(0.0007 inch in 112 foot interval)
Average triangle closure using tubes 0.33 sexigesimal seconds
" " " without " 0.43 " "
Interior angle closure adjustment, 24 station figure: 0.04 second with tubes,
0.08 " without "

FIGURE 2.

and second adjacent stations on each side of it. (Figure 2). This intervisibility permits the observation of closed triangles and because of this and the one centimeter tolerance in the diameter of the circle, it was decided that the expense of radial tunnels for the direct measurement of radii of the circle would not be necessary.

ANGLE MEASUREMENTS

All the angles between the intervisible stations are measured with 16 positions

FIGURE 3.

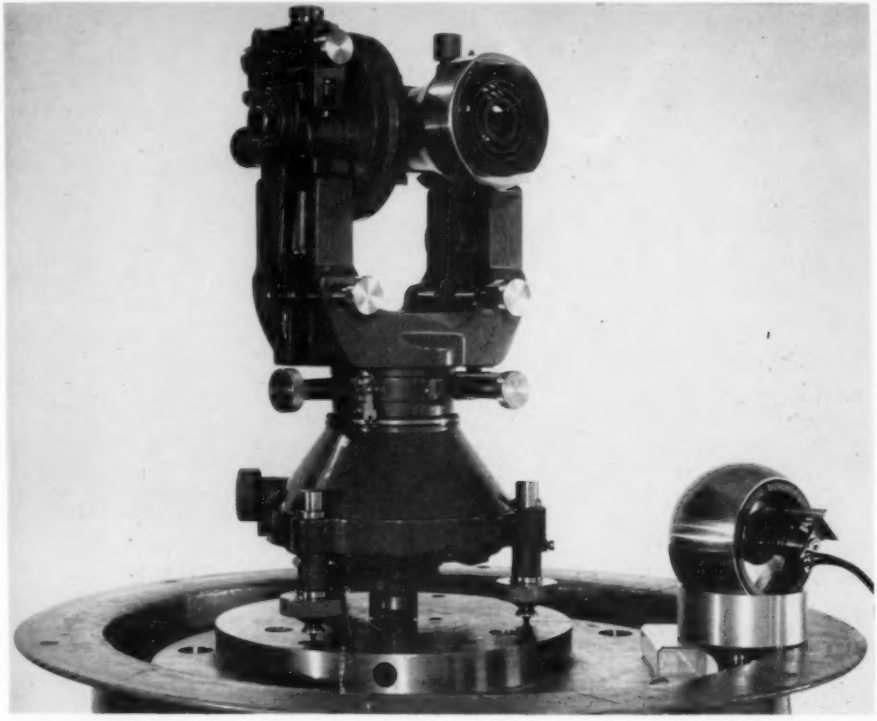

FIGURE 4.

with a specially centered T3 theodolite and special targets (Figure 3). The centering ball on the theodolite and the base cylinder of the target plug fit the bushed hole whose center is the control station within 0.0004 inch (10 microns). The centering of the ball on the theodolite and the centering of the target graduations on its base cylinder are within the 0.0004-inch (10-micron) tolerance also. A second set of discs with holes offset to the amounts necessary to place the stations on the desired circle as computed from the first precise traverse has been substituted for the original discs. The second precise traverse, using the offset discs, proved that the positions are within the specified tolerance.

For the angle measurements, a rejection limit of 3 sexigesimal seconds per single pointing and one second per triangle was adopted. Additional sets of 16 positions were taken in a few instances when these tolerances were not met. The average triangle closures were 0.33 sexigesimal seconds using tubes and 0.43 seconds later without tubes when the air conditioning of the tunnel was in stable operation. The 24-sided figure required an adjustment of 0.04 and 0.08 seconds respectively per interior angle to close the two traverses of the control monuments made thus far.

Recently an interferometric screen over the theodolite objective and a point of light target have been tried for angle measurements with encouraging results. This technique was developed by P. Richardus at the Geodetic Institute of the Technical University at Delft, Netherlands, in accordance with procedures recommended by A. C. S. Van Heel. The apparatus Mr. Richardus used and his test results were described in a paper presented at the Rome Congress of

the International Geodetic Association. A gain of 30 to 40 percent in precision of pointing when using the technique was also reported at the International Surveyors Association Congress at Delft last year.

The apparatus used at Brookhaven is illustrated in Figure 4. The observer reports that for the 112 and 222 feet sights we use in our control survey, the principal advantage of the Richardus technique is that no change of focus is required. It is necessary to refocus with the reflecting or optical targets used heretofore. There is some additional outlay for lights with the Richardus technique. The first triangle closure was two hundredths of a second as compared with 32 hundredths obtained with the reflecting targets but the root-mean-square errors of the pointings were nearly the same with either type of target. Thus far we do not have sufficient experience with the Richardus technique to make a positive recommendation but certainly the technique is worthy of investigation by anyone desiring maximum precision of pointing, particularly if the stations are so close as to require a change in focus of the telescope for the different pointings.

TAPE MEASUREMENTS

Each distance between adjacent and the next adjacent control monuments was measured with specially graduated steel tapes. The average temperature of the tapes was measured by the electric resistance method first developed by the National Physical Laboratory of Great Britain at Teddington. Tension was applied to the tapes by a standardized weight over a carefully selected, balanced, ball-bearing pulley. Eight readings were taken with each of two tapes (using forty power microscopes)—four with the weight raised and four with the weight lowered just prior to contact. The direction of current in the resistance apparatus was also reversed four times. Three tapes were used, the pairs being exchanged so that each tape was intercompared with each of the others for one third of the measurements. The root-mean-square error of the tape measurements of the 112 foot (33 meter) interval between control stations is 17 microns (0.0007 inch). Figure 5 shows the forward contact and tension apparatus; Figure 6 the resistance measuring equipment.

FIGURE 5.

A mean of 72 intercomparisons checked the calibration data given by the National Bureau of Standards within two thousandths of an inch for the 112 foot tapes and within five thousandths for the 222 foot tapes. All three 112 foot tapes agree with each other and apparently with their specified length as compared with the National Standards within four thousandths of an inch, although the Bureau of Standards Calibration Certificates estimate only that the precision of the calibration is within six thousandths. It is very gratifying to those interested in precise measurements that tapes of such high precision are available on special order.

LEVELING

A tolerance of four hundredths of a millimeter (0.001 inch) in the relative vertical positions of the magnets was adopted. In order to attain this, a two-second vial was exchanged for the ten-second vial normally installed on the Wild N3 level. The lengths of foresights and backsights were kept equal

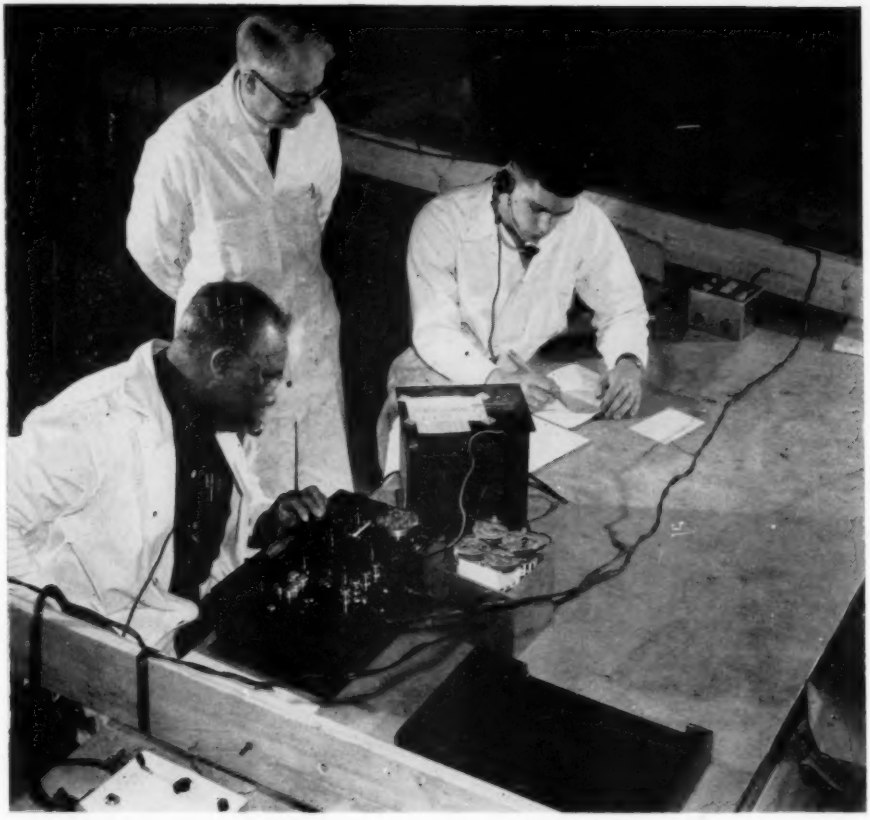

FIGURE 6.

by measurement. Sights are usually about 4 meters and seldom as much as 20 meters long. The closures of the last two leveling circuits around the half mile ring were five and ten thousandths of an inch.

The Keuffel and Esser optical tooling scales have proved very satisfactory for leveling the magnets (Figure 7). During the magnet leveling it was found that the optical micrometer of the Wild N3 level gave errors of as much as plus and minus sixteen ten thousandths of an inch (40 microns) when used over its range of one half inch (Figure 8). If restricted to one tenth inch range the error can be held to less than four ten thousandths (10 microns). However, the Wild Company, appreciating that the application of calibration corrections would be bothersome, is going to supply a specially graduated scale for our N3 level which will compensate for the micrometer deviations and eliminate the corrections.

Such cooperation on the part of instrument manufacturers is very gratifying. It is obvious that we surveyors ride on the backs of the instrument manufacturers for the precision of our work. Sometimes they must think that we want to ride a good horse to death. Nevertheless we do appreciate the cordial and effective way our special needs have been met by the manufacturers. Such precision would be utterly impossible without it.

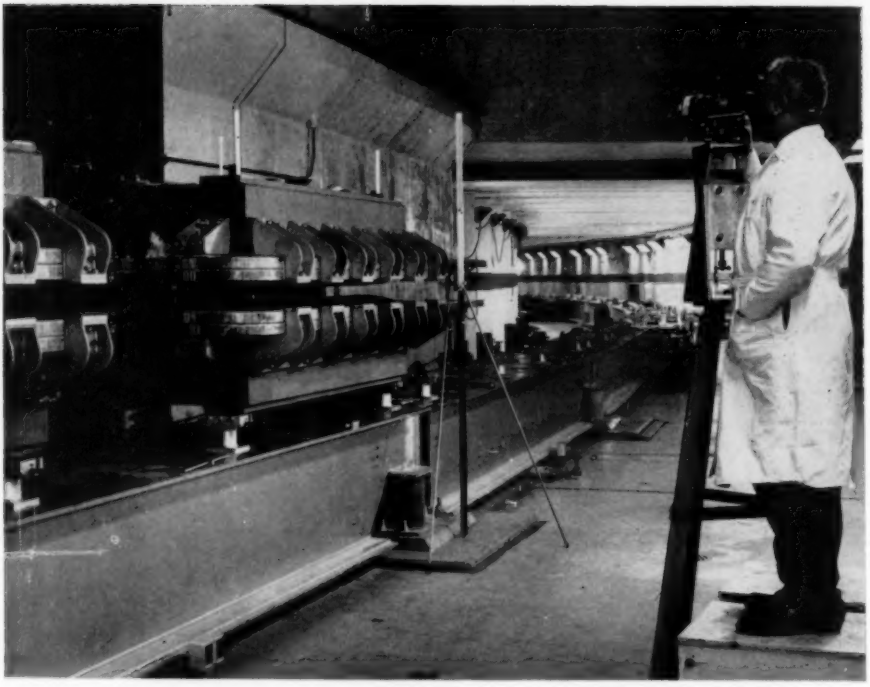

FIGURE 7.

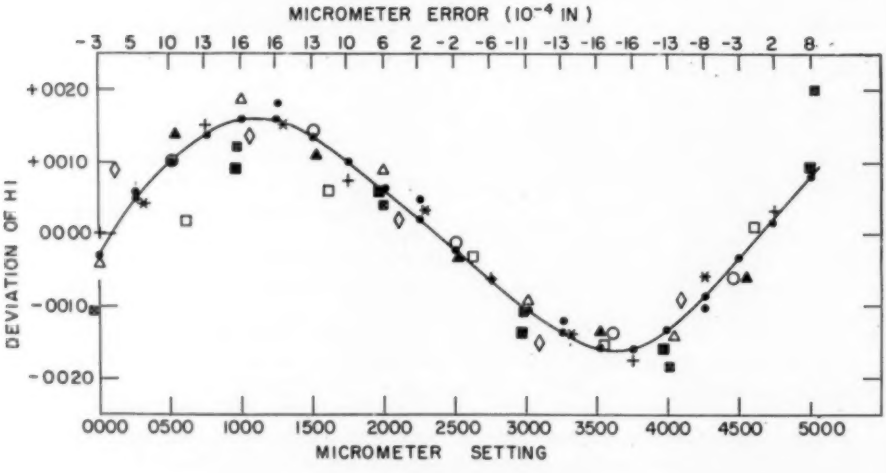

FIGURE 8.

FINAL ALIGNMENT BY OFFSET RADIAL MEASUREMENTS

The preliminary setting of the magnet locating pins was done by means of taped distances and measured azimuths from the 24 control stations. The locating pins are adjustable radially. The final radial alignment will be done by special invar tape offset rods calibrated to the specified radial distances (Figure 9). One end of these

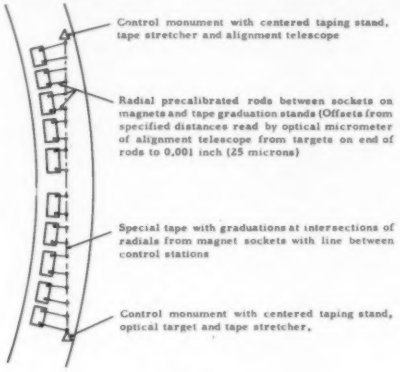
Control monument with centered taping stand, tape stretcher and alignment telescope
Radial precalibrated rods between sockets on magnets and tape graduation stands (Offsets from specified distances read by optical micrometer of alignment telescope from targets on end of rods to 0.001 inch (25 microns)
Special tape with graduations at intersections of radials from magnet sockets with line between control stations
Control monument with centered taping stand, optical target and tape stretcher.

FIGURE 9.

rods fits in sockets on the top of the magnets; the other will have an optical alignment target of the type used in the United States aircraft industry (Figure 10). The

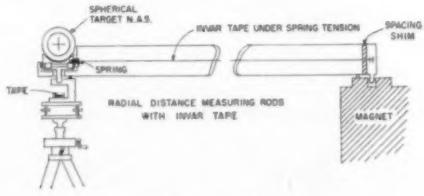

FIGURE 10.

target end of the rods will roll on stands set along a specially graduated tape between the adjacent control stations. The radial displacement of each magnet socket from its specified position will be measured by an alignment telescope optical micrometer to the nearest 0.001 inch (25 microns) (Figure 11). The invar tape and offset bar arrangement will permit considerable fluctuation of the temperature of the magnets without appreciably affecting the accuracy of the radial measurements.

MEASUREMENT THROUGH TUBES

The air conditioning of the tunnel was not in stable operation when the first measurements between the control monuments were made. Rather than wait, it was decided to make both angle and distance measurements through pressboard tubes 12 inches in diameter, such as are commonly used for concrete column forms in the United States. The tubes were supported on lumber scaffolding on small trucks (Figure 12). The root-mean-square errors obtained with measurements through the tubes were about one fourth smaller than those obtained without tubes after the air conditioning had been stabilized within one degree centigrade. Such tubes probably offer a practicable means of measuring with tapes with similar precision when the wind is blowing moderately. A light breeze is sufficient to prevent such precision without them.

REALIGNMENT AFTER FOUNDATION SETTLEMENT

The positioning of the magnet locating pins and first alignment of the magnets to the required tolerances do not complete the survey task. The tolerances in relative position are so close that readjustment for the settlement of the foundations will be required. A vertical settlement of approximatey one centimeter (0.46 inch) has occurred since about 10,000 tons of concrete shielding blocks were placed in the Target Building last spring. Horizontal movements as much as 0.6 millimeter (0.024 inch) accompanied this settlement. The rate of settlement has decreased to about 0.004 inch (0.1 millimeter) per month. It is hoped that the settlement due to this load will be practically completed by the time the magnets are placed in 1959. Each magnet itself weighs 17 tons. Some settlement, estimated at .016 inch (0.4 millimeter), is expected to occur during the first six months after placement

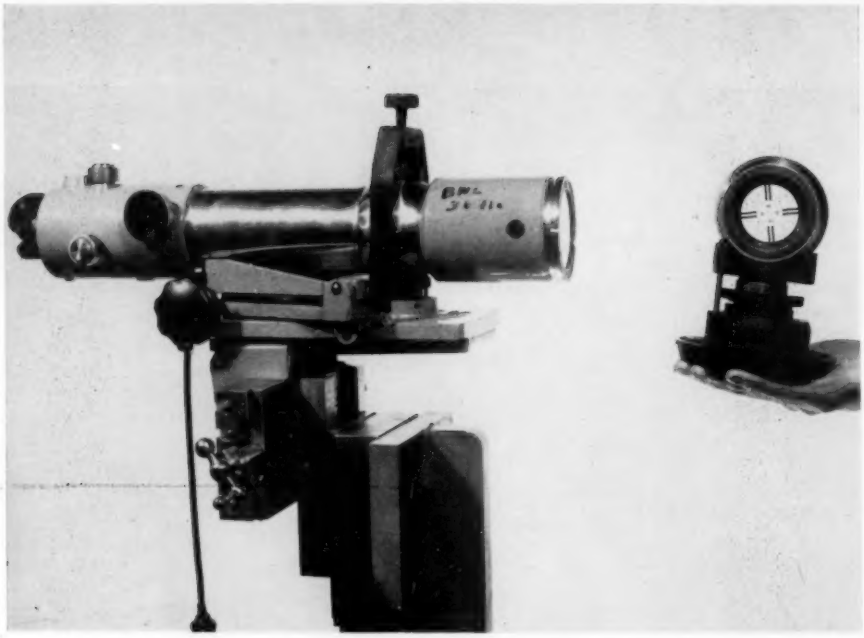

FIGURE 11.

of the magnets and an additional like amount during the first six years. Convenient means of realigning the magnets by screw jacks will be provided. Most of the survey measurements will be repeated at intervals as needed to insure that the alignment of the machine is held within the tolerances. Due to the relatively homogeneous glacial moraine soil, it is anticipated that survey at yearly and longer intervals will be sufficient after the first year of operation of the machine.

Manual of Geodetic Triangulation

A revised edition of Special Publication No. 247, "Manual of Geodetic Triangulation," has recently been issued by the Coast and Geodetic Survey. Revised specifications for first- and second-order triangulation, which have been tightened under certain prescribed conditions, constitute the only change made from the first edition. In Table 1 and on several pages throughout the manual, first-order work has been separated into the following classes: special, optimum, and standard; second-order work has been separated into two classes.

The "Manual of Geodetic Triangulation" describes the approved methods for triangulation surveys of the Coast and Geodetic Survey, and discusses the coordinated operations of reconnaissance, triangulation observations, base measurement, azimuth determination, and special surveys. It also includes an appendix, 136 illustrations, and a variety of tables. The material covered by the manual, which has been prepared from the accumulated experience of many members of the Bureau over a long period of years, embraces modifications and improvements in field operations resulting from progressive changes in the development of triangulation instruments, equipment, and methods.

Special Publication No. 247 is sold by the Superintendent of Documents, U. S. Government Printing Office, at $2.00 per copy.

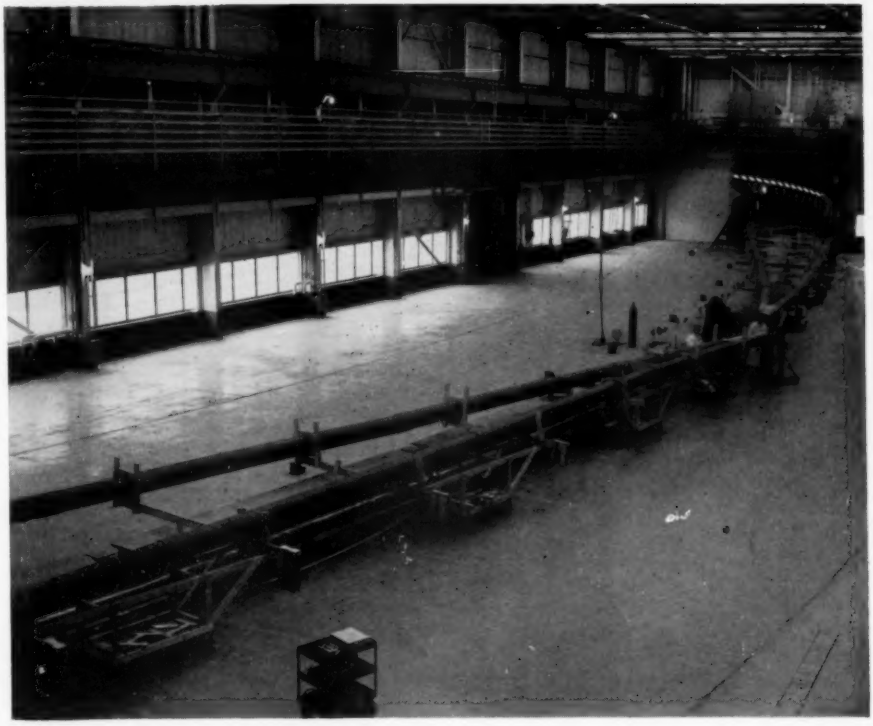

FIGURE 12.

Cartographers Needed

The U. S. Civil Service Commission has announced an examination for Cartographers, with salaries ranging from $4,040 to $12,770 per year —Grades GS-5 through GS-15.

The majority of the positions to be filled from this examination are in the Army Map Service, U. S. Geological Survey, Bureau of Land Management, Coast and Geodetic Survey, Navy Hydrographic Office, and other Federal agencies in the Washington metropolitan area, and the Aeronautical Chart and Information Center in St. Louis, Mo.

Persons appointed to these positions will perform professional work in one or more of the specialized branches of cartography.

Applicants for all grades must have completed an education (or experience equivalent) of a full four-year course of study leading to a bachelor's degree in an accredited college or university with major study in cartography, engineering, mathematics, or physics; or a full four-year course of study leading to a bachelor's degree in an accredited college or university that includes at least six semester hours of college-level mathematics and at least 18 semester hours in any combination of at least two of the following subjects; advanced surveying, astronomy, cartography, descriptive geometry, engineering drafting or graphics, forest mensuration, geodesy, geology, geophysics, mathematics, navigation, optics, photointerpretation, photogrammetry, physical geography, physics, and plane surveying.

For full information write to U. S. Civil Service Commission, Washington 25, D. C., and ask for Announcement No. 196 B, May 19, 1959.

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Surveying for Title Purposes in South Africa

By G. H. HALLIDAY

MR. CHAIRMAN, I want first to thank your Institute very much for inviting me to come here and address you tonight. I have elected to talk to you about Surveying for Title Purposes, because it is a branch of surveying in which I have had considerable experience. Though I have now been in New Zealand for some little time, I have, unfortunately, not yet had as much opportunity of getting acquainted with your methods of title surveying as I would have liked. I hope, therefore, that you will bear with me if you find that, because of its similarity with your methods, much of what I have to say is known to you. I am not going to talk about the complications in which surveyors are involved resulting from the restrictive legislation, town planning and other which affects subdivision of land, nor about the merits and demerits of such legislation because, I suppose that, in this respect, your problems are very similar to our own. However, I may say that, as for a number of years I performed the functions of a technical consultant on land development and disposal, for one of the Johannesburg mining and financial houses, I am probably more conscious than many surveyors of the frustrations in which such legislation can result.

I do not need to tell you that the title surveyor's problem is as easy to describe as, frequently, it is difficult to resolve. I think it is generally agreed that it consists, in essence, of trying to put the beacon back where it originally was. If you could have comparatively permanent property beacons, such, for instance, as heavy piles, driven 40 feet into the ground, and made of some very hard and indestructible material, many of our problems, and, incidentally, much of our work, would disappear.

Our work as title surveyors can, broadly, be divided into two parts. First we must find the beacons, decide which are beacons, and which are not, whether the beacons have been moved, and so on. This aspect of our work differs little, I imagine, the world over. Secondly we must fix the position of the beacon. It is in the manner in which this fixing is done, and the methods used, that, it seems to me, there is the most variation in different countries. From what I have read about the survey methods of various countries I think we, in South Africa, place rather more emphasis on the second part of the problem than they do elsewhere.

At the outset I would like to give a short summary of the history of surveying in South Africa, because it is only when this is known that the form of some of our surveying developments can be appreciated. This, in turn, cannot be done without a brief reference to the history of South Africa itself. At this stage I must warn you that, as, at the moment, I have no suitable references easily available, my recollections of dates may be faulty, and sequences sometimes incorrectly stated.

South Africa was first visited by the Portuguese about the end of the Fifteenth century. It is from the Portuguese that our province of Natal obtained its name. It was, however, only about 1650 that the first European settlement was established. The Dutch East India Company was responsible for this, its purpose being to obtain fresh food for its ships on their way from Holland to the Indies. As the settlement remained mainly in Dutch hands until about 1800, the influence of Holland was profound. It is as a result of the Dutch ad-

Read to the Wellington Branch of the New Zealand Institute of Surveyors, March 12, 1958.

EDITOR'S NOTE—This paper has, for a variety of reasons, been published strictly in accordance with the manuscript as furnished. Spelling, punctuation, and terminology of the original paper have been followed closely. This has been done deliberately in an earnest effort to avoid the possibility of conveying the wrong impression through inadvertance, as might easily happen if we attempted to make this paper consistent in style with other portions of this publication.

ministration that the basis of the South African legal system is Roman Dutch, and not English law, as it is in most of the other English colonies and in the United States of America. I am not a lawyer, and do not pretend to know the intricacies of the law, but it is evident that Roman Dutch law has considerably influenced the development of the law in regard to the registration of title to land in South Africa. I think I am correct in stating that it was because we had a settled and easily workable land registration system under Roman Dutch law that the Torrens system of land registration, which you have here, was not introduced into South Africa. I may mention at this point that, under our law, acquisition of title to land by prescription is still legally possible.

Later, the English administration and Privy Council appeals must have considerably influenced our law, but there are still some marked differences with English law. I believe that the nature of the rights in land which may be registered is more restricted in South Africa than it is in other commonwealth countries. A more homely example of the consequences of Roman Dutch law, and one which your members may find more interesting, is that, in South Africa it is not possible for you to have a banking account jointly with your wife!

A legacy that we have inherited from our Dutch origins, which has a more direct interest for surveyors, however, is our unit of measure. This is the Cape Foot. Earlier we also used the Cape Rood, which is equal to 12 Cape Feet. The legal relationship between the Cape and English foot is:–

1000 Cape Feet = 1033 English Feet.

The history of the Cape Foot is that, in the early days in South Africa, the unit of measure was the European Rhynland foot. In those days transferring a standard of measure was more of a problem than it is today, and such transfers were frequently not particularly accurately made. I believe that the practice was to mark off a twelve feet length, that is a Rood, on a wooden plank. Due to a variety of fairly obvious reasons it was later found that the Rhynland foot, as used in South Africa, differed materially from the parent measure. Finally, by act of the Cape parliament, the measure was standardized at the ratio stated above, and called the Cape Foot.

In all but one province of South Africa the Cape foot is now the legal measure for title work. Although the measure used by engineers, architects, builders etc., is the English foot, the Cape foot is so rooted in tradition and sentiment that it is not without difficulty that it will be abandoned. It is in many ways an embarassment to the surveyor because it is now very little known outside the profession and almost invariably, in urban surveys at any rate, the surveyor has to convert the dimensions which are shown on the title diagram to English feet before they can be understood by his client. The square measure for the Cape unit, that is the morgen, is, however, extensively used in land transactions, particularly in the rural areas. A morgen is equal to a little over 2 acres.

I notice that you, too, are not without some complications in regard to units of measure. You have our old friends the chain and the link. They are still retained by our engineers, in railway surveys. We have, however, dispensed with the rod, pole or perch, in our title work, in Natal, which is the only South African province in which English measure is used for that purpose.

As a legacy of the German Administration, the metre is used in title work in South West Africa, which has been administered by the South African government since the first world war. There has for many years been talk of making the metre the legal measure for the Union. It is my opinion that there are difficulties, which are not always appreciated, in introducing the metric system into commonwealth countries. I always find it difficult when a continental friend tells me he is 1.84 metres high, and I don't relish giving a builder a plan dimensioned in metres. For survey purposes we have decimalised our foot, as you, I suppose, have the link, and I think this is much more important. Even pressing the decimalisation of the foot the further stage, into,

for example, the building trade, is not going to be easy. The inch is very firmly rooted and the duo-decimal system, though today rather apt to be discredited, has one important advantage over the decimal system. The common fractions, such as one quarter, two thirds, etc., of a foot, can be much more concisely expressed in inches than they can in decimals of a foot.

You may be interested to know that the United States, too, has difficulties with now little used measures in some of its older title surveys. The viajo, formerly used by the Spaniards, in what is now one of the western states, Texas, I think, still appears on old title diagrams.

Finally, on this subject I may mention that Holland, which exported the Rhynland foot to us, thereafter, it may be as a result of the Napoleonic wars, I am afraid my history is rather poor, adopted the metre.

From the earliest times in South Africa the endeavour has been to have a plan or, as we call it, a diagram, representing the land described, annexed to each title. In the older titles this was little more than a sketch on which no numerical data were shown. Later, dimensions were added. At first these were the sides and angles of the geometrical figure formed by joining the corner beacons of the property. Subsequently it became the practice, in addition, to show the rectangular co-ordinates of the beacons. For urban property this procedure, of attaching a diagram to the title, must go back a very long way. One of the principal shops in Cape Town is still held on a title dated about 1722, and there is, I believe, a plan attached to this title.

As the settlement at the Cape extended, however, and farmers gained title to large rural properties, it was often difficult and inexpedient to have the land surveyed before title was issued. A common practice in respect of such land was for the local official called, in the Transvaal and the Orange Free State, the "veld cornet," to mark the centre of a property by a beacon. Each farmer was entitled to about 3000 morgen of land. This was defined by the veld cornet by riding his horse out from the center beacon for a prescribed time in each of four directions and marking the outer limits by further beacons. I do not need to tell you that later, when the properties came to be surveyed, discrepancies in the boundaries of properties were not uncommon. Sometimes this is reflected in the names which farms bear today. If you find a narrow enlongated property on the cadastral map, and it is called Uitvalfontein (fall-out-fountain), no further explanation is necessary. I imagine that the practice of showing numerical data on title diagrams probably commenced about 1800. Later, because serious inconsistencies in these data had sometimes been found, it became the practice for them to be officially checked for consistency, before registration of the diagram. This was the task of the Surveyor-General's office. I rather think, I hope that I am not doing him an injustice, that this was how the Surveyor-General's duties began. The Surveyor-General from an early date adopted the practice of filing a copy of each title diagram in his office. A further copy of the diagram was filed in the Deeds Registry with the official copy of the title, and a third copy was annexed to the owner's copy of the title.

It was some time after the middle of the last century that the use of plane rectangular co-ordinates in surveys was introduced into South Africa. As you no doubt know, it is to the French mathematician Puissant, that the idea of the use of plane rectangular co-ordinates in surveying is attributed. Marquard, who was Surveyor-General at the Cape at the time, read Puissant's treatise and substituted a system in which bearings increased in a clockwise direction, so that it could more easily be used with conventionally graduated theodolite circles.

After the introduction of rectangular co-ordinates the use of triangulation in title surveys by South African surveyors rapidly developed, until it soon became the principal method of fixing position.

At the outset, with a few exceptions, in some of the urban and mining areas, surveys were not based on uniform co-ordinate systems. In general, the surveyor measured a base, on or near the property to be surveyed. Thereafter he determined a simple astro-

nomical azimuth, assigned zero, or other convenient arbitrary co-ordinates to one end of the base, and proceeded to triangulate.

The advantage of having the co-ordinates of title surveys based on a general survey system was early recognized. There is an interesting report by the Surveyor-General to a Cape parliamentary committee, appointed to investigate the matter in 1876. In the legislation of the two Boer republics there are a number of provisions for the establishment of such surveys. Expense, as it so frequently is, was one of the main deterrents. It was not until well into the present century that uniform rectangular surveying systems, officially established, became sufficiently developed to permit of connection of title surveys being commonly required.

Some general surveys had, of course, been made much earlier, but none of them was of any great extent. The first of such was that carried out by a French scientist, the Abbe la Caille, at the Cape. The beginning of our present geodetic survey was, however, largely due to the initiative of Sir David Gill, the Cape Astronomer Royal, towards the end of the last century. Conversion of the geographical co-ordinates to rectangular and the breaking down of the main triangulation to a low enough order to permit of general use of it by private surveyors did not start until much later. This work was organized by van der Sterr, our first Director of Trigonometrical Survey, in the nineteen-twenties. He chose the Gauss conform projection as being the most suitable for our circumstances. As you no doubt know, the Gauss projection is, with differences so small that, for ordinary purposes, they may be described as academic, similar to the Transverse Mercator. Before he was appointed Director, van der Sterr was a well known and successful private practising surveyor. I believe it was his experience of title surveys that led him so to limit the width of the projection zones that it is practical to use the co-ordinates for title surveys, even on the edge of the systems. Generally the extent of rectangular projections is determined by the mapping authorities, who, understandably, are concerned to make them as wide as possible. On this account they generally fix them at such widths that the extent and complication of making the corrections for scale and convergence at the edges deter title surveyors from making use of the co-ordinates. Despite the minor inconveniences of making the corrections which are necessary, even for a system of limited width, I think there are a lot of advantages in having all surveys, including those made for mapping, engineering and title purposes, on the same co-ordinate system.

Our survey systems are centered on alternate meridians and extend for one degree of longitude on either side of the central meridian. So as to enable the corrections to the directions to be effected in as mechanical a manner as possible the central meridian is taken as one of the origins. This, of course, necessitates the use of positive and negative co-ordinates. Negative co-ordinates are not, however, really much of a disadvantage except for military surveys. The other co-ordinate axis has been taken at the equator. This latter may seem unnecessarily extensive but it has potential advantages when you are on a large continent, as we are. As a result of it, the Central African Federation has been enabled to adopt our systems by extending them into its territories. Later other African territories may possibly follow suit. In a quarter degree belt on the edge of each system co-ordinates are computed on the adjoining system as well.

The history of our country is rather different from yours in that the separate provinces had long periods as separate entities before union was finally brought about in 1910. Except for short periods, two of the provinces, the Transvaal and the Orange Free State, were separate Boer republics, from their establishment, about 1830, until the time of the South African war, at the beginning of the century. It is not surprising, therefore, that each of the provinces had survey developments which differed in some respects, and that each had its own separate survey legislation. In Natal, for example, with its English origin, the unit of measure was the English foot and the acre, and these measures are retained in Natal at the present day. Fortunately for uniformity of prac-

tice, the influence of the parent settlement at the Cape was always strong in the other provinces. Most surveyors qualified in the Cape, and, once licenced there, needed to do no more than comply with simple formalities and pay a licence, before being permitted to practise in the other provinces. At the present day the influence of South Africa has extended, and most surveyors for British African territories, up to the equator at least, are South African trained.

For a variety of reasons it took a number of years before the South African parliament could deal with all the consolidating legislation necessary to cover the various aspects of the activities of the country. It was not until 1927 that a uniform survey act was passed and, owing to the labour of framing regulations under this act, it was 1929 before it was enforced. With minor amendments and alterations this is the law under which our surveyors now work.

In many ways the Act did no more than consolidate and make uniform previous laws and practice. It did, however, introduce some very important changes which have considerably influenced the development of title surveying since that time.

The Act confirmed the existing organization, under which there was a Surveyor-General in each province, and a Director of Trigonometrical Survey for the Union as a whole, and it created a Survey Board consisting of these officials. It also created a Survey Regulations Board, consisting of practising surveyors and government officials, which meets from time to time, as the necessity of framing or amending survey regulations arises. It is this Board which determines the surveyors' fees for recommendation to the Minister under the Act. The Act further made provision for the appointment of a Director General of Surveys, who could take over the functions of the Survey Board, but, until quite recently, no appointment under this provision had been made.

Before the passing of the Act no variation of the data shown on a registered diagram was permitted on any subsequent diagram of any part of the land represented on the original diagram, unless all the complicated formalities for an amendment of title has been completed. These formalities involved obtaining the consents of all adjoining owners, and this was generally a very lengthy and costly business. The new Act, following an amendment to strengthen it, which became necessary as a consequence of a decided case, permitted variations with registered data up to a prescribed maximum, without the necessity for an amendment of the original title. This provision of the new law has removed a nightmare called red and black data which previously plagued surveyors. The use of red and black data was a device introduced previously in an endeavour to overcome the difficulty of reconciling the data from a new survey with the original. You calculated your survey according to your own measurements and then recomputed it so as to fit the original data. If the original survey was very old, sometimes the differences were very large. You showed your own data in red on the diagram and the recomputed data in black. The black data were the official data and the black area was used for transfer purposes, but, if another surveyor was subsequently looking for your beacons, he would, of course, use the red data.

Perhaps the most profound change brought about by the 1927 Act was that it compelled surveyors to submit complete records of every title survey to the Surveyor-General for examination and for subsequent permanent filing in his office. These records comprise the field notes, calculations, a special and separate working plan, and any reports, etc., that may be called for by the Surveyor-General. Previously, with very few exceptions, the surveyor only submitted the final title diagram to the Surveyor-General, who limited the technical part of his examination, to recomputing the data on this diagram so as to test these for consistency. It will be evident that the Act brought a fundamental change in the relationship between practising surveyors and the Surveyor-General. As I have worked for some time as a professional assistant in the Surveyor-General's office, administering the Act, I have had the opportunity of seeing the new system from both sides.

It is only when a surveyor's records have been approved by the Surveyor-General that his diagrams are certified by that official so that they may be used for registration purposes. If a surveyor wishes to examine the records of previous surveys he has made, he must do so in the Surveyor-General's office, or the Surveyor-General will supply him with copies of the parts of his survey which he requires. The question of whether one surveyor should have access to the records of another in the Surveyor-General's office is one about which there are conflicting opinions. There is considerable variation in the practice in different Surveyor-General's offices in this respect. The actual title diagram is, of course, a public document, so that no difficulty arises in regard to its inspection. The Surveyor-General furnishes a surveyor with data of previous surveys, usually photostat copies, free of charge, upon application, in respect of any specific new survey.

In all areas where the government trigonometrical survey has been broken down to a sufficiently low order, surveyors must, subject to prescribed conditions, connect all their title surveys directly to it.

The 1927 Act finally fixed title surveying as a closed profession in South Africa. Understandably, therefore, the government has retained a large say in the determination of our fees.

The survey profession in South Africa was, formerly, separately organized in four provincial institutes, all but one of which, I think I am correct in saying, has compulsory membership. Now, however, the control of the profession has been unified by the Surveyors Registration Act, which was passed about 1950. This Act retains the provincial institutes, but gives wide disciplinary powers to a Central Council. Members of this council are nominated by the provincial institutes and there are government appointees. The Registration Act requires a very close personal supervision to be exercised by the surveyor, particularly in regard to field operations, and very specifically defines the nature of this supervision. The Act makes registration of practising surveyors compulsory.

I should now like to say a few words about the methods of fixing position which we use. Wherever he conveniently can, the South African surveyor triangulates. We only swing the chain when triangulation is not economic, or convenient. Of course, there are many occasions when we have to traverse; in developed town areas, for instance, and in flat bush country, where we have no alternative. I have seen some very long traverses, up to 300,000 feet, in title surveys, at times. It is, however, surprising how much can be done by triangulation when your mind is running that way. Formerly we used the conventional triangle solution, through the sine formulae. The practice was to fix by one triangle and check with a second. Later this method gave way to the method of the "Point Approche," which is widely used on the continent of Europe. The method seems mainly to have been introduced into South Africa by van der Sterr, when he was practising in Johannesburg in the early years of the century. Later, when the 1927 Survey Act was passed, the point approche methods were largely standardized in an annexure attached to our survey regulations. The method is known today in South Africa as the "Graphical Method." The advent of the calculating machine and good tables of natural functions, such as Peters 6 Figure Table, permitted a streamlining of our calculation methods. In particular, the calculating machine enabled us to dispense with the sine formulae solution for the triangle, and to substitute the formulae which employ the tangents (or cotangents) of the bearings. These formulae, as you no doubt know, require only the co-ordinates of the base points of the triangle and the bearings from the base points to the apex to be known. They thus avoid the necessity for taking out the angles of the triangle and for computing the distance and bearing between the base points. They are particularly suitable for the graphical method, where the endeavour is to work everything on bearings.

It will be appreciated, that, with the methods of survey we use, where almost every point is fixed either by triangulation or traverse polar, the important data are the

co-ordinates. In fact all other data on a diagram are derived by computation from them.

The tendency towards uniformity with us in our ordinary work has been to reduce our calculations to a very limited number of standard or almost standard processes. This enables us to avoid the necessity of memorising formulae and yet avoid using set printed forms, with its attendant inflexibility.

Now I should like to mention a few of the types of beacons we use. For our trigonometrical beacons the standard is a cylindrical concrete pillar about 4′6″ high, of about 18″ diameter. During construction a pipe is placed in the centre of this, flush with the top of the pillar. Into this pipe slips a second pipe to which a vane is attached. This vane consists of two sheets of galvanised metal, of about the same width as the diameter of the pillar. When you want to observe at the beacon you just withdraw the vane pipe and place your theodolite on the beacon over the centre pipe. Many surveyors have a small fitting with three short metal legs, about 1″ long, onto which the theodolite is screwed. The pillar is white washed and the vane painted dull black. The vane given extra height to the beacon for observing to, provides a contrast, and helps you to avoid the error of phase, which can, otherwise, arise if the sun is shining on the side of the pillar. This error of phase can at times provide an interesting optical illusion on these beacons. One of the drawbacks of this type of beacon is that a number of the pillars are split as result of the vane being struck by lightning. Beaconing of title corners is always a problem, and no doubt it is with you. For the rural areas the Rhodesians have evolved a practical and inexpensive beacon. You build a cemented cairn round a pipe centre. Otherwise we use a variety of beacons; angle irons, iron fence standards, iron pipes and pegs, usually covered by a cairn of stones and sometimes set in concrete. In urban areas, for township sections, round iron pegs of ½″ or ¾″ diameter are almost invariably used. I think it is generally agreed that none of these is altogether satisfactory, but it is difficult to find reasonably economic alternatives. In subdivisional surveys it is always a problem to know which, of the few pegs you can generally find, have been shifted. It is quite a common thing for the fencer to remove the peg and put the fence post exactly in its place, and finally replace the peg alongside. Municipal officials have been known to effect somewhat similar replacements of town reference marks after having removed them to make way for a water or gas pipe, or other municipal reticulation.

Because of our methods of survey, almost all South Africal surveyors use the single second optical type of theodolite. With very few exceptions, we do not use the narrow steel measuring band that you employ. Formerly we used a 300′ × ⅛″ band (or wider than that in earlier times). Such a band is divided throughout its length in feet, the feet marks being continuously numbered. Latterly, however, a ¼″ × 300′ tape, divided to hundredths of a foot has become popular. I should mention, however, that the surveyor for the Rhodesian Railways has been using New Zealand type bands for many years. They are made for him, graduated to chains, or it may be to Cape feet, by Bolt and Sutherland of Wellington. So you see, New Zealand has been exporting other commodities to Africa as well as Prime Ministers and Canterbury lamb!

Normally a surveyor in South Africa qualifies by taking a B.Sc. (Survey) degree at one of the universities. This is a four year course. As part of the university course, students have to complete a prescribed amount of approved practical work in the university vacations. After completing the degree course the student has to serve articles satisfactorily, for a period of not less than nine months, with a registered surveyor. After approval of the student's articles by the Survey Board, he is eligible to apply to perform the trial survey and write the examinations on survey law which are the final requirements before admission. This trial survey is set for the Survey Board, which is the examining body, by the Surveyor-General of the Province in which the student is resident. The trial survey is mainly concerned with title survey, and the student

has to perform a title survey of a specified piece of land and prepare all the documents. He is, however, also required to measure a base and extend a triangulation from it, to perform a topographical and contour survey, and complete a field astronomical programme. The survey degree is an outcome of the diploma course, which surveyors formerly used to comlete. For the diploma course students spent a minimum of two, and generally three years at the university, and had, thereafter, to serve articles for a minimum period of two years. The diploma course has of late years been little used and is, I believe, now finally to be abolished.

In new development, title surveying is largely a technical problem. However, and I suppose that it is your experience, too, when it is a question of re-establishing boundaries and of subdividing in established areas, law plays an ever increasing part. It is my opinion that in the future, it is going to become even more essential that our incoming surveyors are well grounded in basic legal principles and in the case law affecting boundaries. It may prove necessary eventually for this aspect of law to become a regular subject of the university course.

The Johannesburg goldfields, where I spent most of my practising life, is the most densely populated and developed part of South Africa. The multiplicity of interests in land which you have there has produced a number of problems. Rights to land in this area can roughly be divided into two categories. Firstly, there are those which pertain to freehold and rights subsidiary thereto, such as easements, leases and so on. Secondly, there are rights relating to mining. Of course there is some overlapping. Nevertheless, the distinction is fairly sharply defined, more particularly as freehold rights have to be registered in a different registry from mining rights. These two registries are situated in different towns. Each keeps its own compilations of the rights which it registers, but, in general, does not show the rights registered in the other registry. This does not assist correlation of the two categories of rights which is sometimes necessary. Under our mining laws, after discovery of precious metals, the owner of the mineral rights over an area of freehold land is entitled to a certain mining area. He may, in addition, apply for a mining lease over a further part of the mineralized part of the freehold area. When these rights have been selected the whole of the mineralized area is proclaimed under the Gold Law. The effect of this proclamation is that, thereafter, the mineralized area falls under the jurisdiction of an official called the Mining Commissioner. After proclamation no person, including the freehold owner, may use the surface of the land for any purpose, except with the written permission of the Mining Commissioner. All the permissions granted by the Mining Commissioner have to be defined. The permissions cover almost every form of activity by the mine owner and other persons. They include such rights as those to dump waste rock, to lay pipe lines, to establish a trading store, to use land for agricultural purposes, and so on. All rights defining actual mining areas and many of the permissions have to be surveyed by a registered title surveyor, and approved by the Surveyor-General.

Surveying on the goldfields can be further complicated by the underground surveys themselves. Underground surveys are not ordinarily the function of the title surveyor. A separate certificate of competency is required before a title surveyor may undertake underground surveys. Generally mine surveyors only have the mining surveying qualification, and are employed as full time officials by the mining companies. Mine surveys, too, however, all have to be co-ordinated. Consequently the title surveyor is sometimes involved, particularly if there is a survey difference underground on the boundary between two adjoining mines. I was once involved in such an investigation and had to make an exhaustive analysis of the causes of the differences, which were rather large.

The investigation brought to my notice, for the first time, the conception of the third dimension in title surveying. Instead of a corner being defined by one beacon, I realised that it could be defined by a series of beacons, at different levels, which, theoretically, should lie on the straight line joining

the surface beacon to the earth's centre. Surveying is not an exact science and, even the best surveys can, for economic as well as technical reasons, be performed to a standard of accuracy only. The beacons at the various levels could, therefore, be expected to deviate from this theoretical straight line by amounts which would depend on the accuracies of the surveys concerned. I did not, in this case, have to carry my conclusions beyond the academic stage! These are, however, problems which, in a modified form, may have to be faced when the stratified titles, of which there is much talk today, come into registration systems.

Another consequence of mining, and one not altogether divorced from the above problem, is that beacons have been found to move due to subsidence arising from mining operations. Near Johannesburg the gold reefs, which are generally of very limited width, from 2 to 6 feet, dip from the surface at angles of the order of from 30 degrees and more. When the reef has been mined out the tendency is for the ground on the hanging wall side, even at some distance from the outcrop, to move towards the footwall side. This movement, of course, carries the beacons and structures with it. Frequently, except at the outcrop itself, the movement is not revealed by breaks or other surface indications, and, when the beacons are more or less parallel to the outcrop, the movement could be of quite a regular nature. The complications which might flow from this movement are, I think, fairly obvious. So far the courts have not been called upon to adjudicate upon them.

ACSM Delegates to F. I. G. Meeting in Krakow, Poland

ACSM official delegates attending the permanent committee assembly of the Federation Internationale des Geometres at Krakow, Poland, September 4–7, 1959, are: President George C. Bestor, Vice President H. Arnold Karo, Lester C. Higbee, and Charles A. Whitten. At this meeting the ACSM's application for affiliation with F. I. G. will be formally considered.

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The Role of the Topographic Map in the Missile Age

By COLONEL FREDERICK O. DIERCKS

COMMANDING OFFICER, ARMY MAP SERVICE

IN THESE DAYS of science-fiction-come-true, there is an increasing tendency to look at any of man's old activties with a puzzled expression and ask, "What, are you still here?" Of course, it's always the other person's activity that gets this look. Thus it comes about that, while we in the mapping business know that topographic maps are finding increased application all the time, a large part of the general public wonders if maps aren't on their way out, at least for military purposes.

It is hardly necessary for me to assure this audience that maps will continue to have a military role in the missile age. Since it is also evident that this role may be considerably different from that of the recent past, I would like to devote this short talk to an exploration of the differences.

MAP USE IN WORLD WAR II

I will begin by reviewing the ways in which the Army used topographic maps during World War II. Now, this is going to be familiar ground for a good many of you. If you will bear with me for a few minutes, I will attempt to refresh your memories.

Maps were used for the *formulation* of plans and for the *execution* of plans. Planning on the strategic level was concerned mainly with maps at a scale of 1:250,000 and smaller. These maps provided an appreciation of the terrain as it would affect operations in the movement, concentration, and supply of troops. As examples, the maps showed the barriers to overland communications, the avenues of communication between those barriers, and areas available for the deployment of armor or the construction of defensive lines.

On the tactical level of planning, maps at a scale of 1:250,000 and larger were used to locate areas where cover or concealment were available; to locate areas where it was possible or necessary to dig field fortifications; to locate sites for the construction of roads, bridges, and depots; and, most importantly, to take intelligent advantage of the terrain in the deployment of troops.

The final planning service for which maps were required was the dissemination of the plans to the operating elements. Plans were necessarily distributed in the form of overprints or overlays plotted on topographic maps.

Now, let's look at the ways in which maps were used operationally, in the execution of the plans. Since artillery support is the most clearcut example of an operation basically dependent on maps, we will start there.

If you compare the operation of field artillery pieces with the operation of cannon from a tank or an airplane, the essential difference is the matter of being able to see the target from the gun. Field artillery batteries are deliberately placed where they cannot be seen from the target, and therefore the gunners are unable to aim directly. Naturally, they do not fire blindly, either. If at all possible, the fire is observed by someone who can see the target, but the important point is that the observer is never at the gun.

Under these conditions, the artilleryman is totally dependent on a map. If he can plot the positions of the gun and the target on a map and then orient the map, he can and must rely on the map for his aiming instructions. To anticipate a point I want to enlarge on later, his relation to the unseen target six miles away is the same in principle as is that of the man who must aim a 6000-mile Inter-Continental Ballistic Missile.

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How did our World War II artilleryman locate and orient his battery on the ground and on the map? If he had the time, he could have a surveying crew run a traverse from the nearest horizontal and vertical control points, to give him his own private control point at the battery. The survey would also orient the battery by carrying an azimuth from the initial control point.

Maps assist in aiming of tactical weapons.

Since he usually did not have the time, however, he often had to rely simply on matching visible ground features with their mapped representation. This permitted the location and orientation of his battery by inspection or by a simple resection.

His targets were either fixed or transient. Some fixed targets (for example, crossroads) appeared on the printed map. Others were field installations which could be located by comparison with mapped detail. Transient targets, known as targets of opportunity, had to be located rapidly by an observer by relation to mapped detail.

It should be clear that an ideal artillery map would have a great amount of identifiable topographic deail, all positioned within very close tolerances. It also required a grid, based on a suitable conformal projection, which would permit all measurements and computations to be in rectangular coordinates.

Another common operational use of maps was for close-in air support of ground operations. Although the objective of such support was the same as that of artillery support, the way in which it relied on maps was certainly different. Here the man in the airplane who wielded the weapon was able to aim visually, although he usually could not choose his target visually. This job was done by artillery marking the target with colored smoke, or by an observer on the ground. For the artillery technique, map position accuracy was a requirement; for the ground observer method, recognition was the problem. The ground observer needed enough map detail to locate his targets and to transmit this information unequivocally to the pilot. The pilot's most pressing need was rapid, positive recognition of his approximate position with respect to the targets. There is no paradox in the use of the words "positive" and "approximate" in the same sentence. The pilot did not need an accurate position, but he had to avoid an erroneous position. And he had to have his position fast. These conditions would impose their peculiar requirements on the selection of detail to be shown on the map, if a mapping agency were to attempt to compile such a special-purpose map.

Most of the other tactical uses of maps were quite similar to the familiar civilian uses with respect to what they required of the map. Such operations as earth moving, construction, movement in vehicles and on foot, and reconnaissance imposed only one peculiarly military requirement on the map. This was the mapping of woodlands, which was a reflection of the ground soldier's eternal preoccupation with cover and concealment from enemy fire.

So much for the second World War. Now we are in position to examine the probable effects of the new weapons on the use of

As with conventional artillery, maps will be required for the aiming of missiles.

maps. The new weapons I want to consider particularly are nuclear warheads and guided missiles. Let's take the more glamorous subject of missiles first.

MAPS FOR GUIDED MISSLES

I mentioned earlier that as far as the relation between launching site and target is concerned, the guided missile is similar to conventional field artillery. The similarity is greater in the case of the shorter-range missiles, of course, but it is really true for all missiles. Consider the problem of aiming a missile to hit a target perhaps 100 miles away. The launching site for such a missile would be hastily prepared, and would be occupied for only a short time. It must frequently be located and oriented on a map, just the way our old artillery battery was. The difference is that the azimuth, or orientation of the launching equipment must be more accurately determined, since the distance by which the missile misses the target is of course equal to the tangent of the azimuth error muliplied by the range.

The target must also normally be located on a map, in exactly the same manner as an artillery target. Again, the target may be a point already printed on the map, but is more likely to be a field installation or a target of opportunity which must be located with reference to mapped detail.

One additional complication comes up now. The launching site and the target are not on the same map sheet. Therefore, instead of merely relying on the internal accuracy within one sheet, the man who aims the missile requires the additional property of his maps that true distances and directions can be carried over a group of sheets. The Army Map Service has introduced the Universal Transverse Mercator Grid for just this requirement, and this grid now goes on all our topographic maps.

We can sum up by saying that the use of short-range missiles is just as heavily dependent on topographic maps as field artillery ever was. With the addition of the UTM grid, the same type of map is needed for both weapons. I'll take up the question of possible changes in map scales later on.

Now let's consider, by way of contrast, the problem of aiming an Inter-Continental Ballistic Missile (ICBM). Again, the

launching site and the target area must be located on maps of some sort. Since the launching site is a fixed installation, which takes considerable time to build, it will doubtless have its own control point. That is, the position and elevation with respect to the earth's coordinate system will be found by means other than scaling off topographic maps.

The position of the target, on the other hand, will still have to be scaled off a map, as a rule. This will normally be the situation where there was enough control to make the map initially and where a point on the map which is not a control point later becomes a target.

A new factor comes into the aiming situation for an intercontinental missile. Because the distances involved are so large, it is no longer sufficient to scale coordinates from a rectangular grid on a map. The positions of launching site and target must be known precisely in terms of geodetic coordinates; that is, latitude and longitude on a spheroid. As you all know, that information is not available on an intercontinental basis to the extent we would like for all areas. The system of control points on each continent is consistent within itself, which is what we mean when we say that all the points are on the same datum. But before we can confidently give the distance and direction between a point on one datum and a point on another datum, we must have solved the basic problem of geodesy to a tolerable extent. The efforts of the Army Map Service in eclipse observations, lunar occultations, and satellite tracking are all attempts to solve this problem.

The effect of intermediate range missiles on the requirements for maps is intermediate between that of the short range and the ICBM's, of course. In several important respects, the trend in the development of new intermediate range missiles is to make them increasingly resemble short-range missiles in their map requirements. While the present IRBM's must operate from fixed, cumbersome launching facilities, the future solid-fueled missiles will be launched from simple, hastily occupied sites. The positions of these sites will often have to be scaled from maps. With the expected improvements in accuracy and reliability, IRBM's could be employed against temporary targets, such as enemy short and intermediate range launching sites. This would call for an artillery type of map, except that the scale could well be smaller.

So far, I have mentioned nothing about the guidance of the guided missile. Now, it is not necessarily true that a knowledge of the geodetic positions of the launching and target points alone is sufficient to get the missile from one to the other. Much depends on the type of guidance system. A guidance system which relies on the earth's gravity field en route would of course benefit from a detailed knowledge of the changes in that field from place to place. This is another aspect of the basic geodetic problem, and such information as exists can best be presented in map form.

There is another type of guidance system which operates by examining the terrain beneath the missile. It continuously compares the observed pattern with a special map which predicts the appearance of all the terrain along the missile's prepared path. Since the predictive map is made synthetically from topographic maps covering the entire path, the potential impact of this system on the topographic mapping program is obvious.

To sum up, missiles may need topographic or special maps for guidance, and they will certainly need topographic maps for target location. This is not to say that a topographic map for target location should contain exactly the same information as the present artillery map. A series of investigations is necessary to determine what the differences should be. Some of these investigations have already been undertaken by the User Requirements Division of the Army Map Service.

NUCLEAR WARHEADS AND MAPS

Now let's consider that noisy partner of the guided missile, the nuclear warhead. I want to treat it separately, since its effect is largely independent of the vehicle that delivers it. As long as the possibility of its use exists, every phase of ground warfare is dif-

ferent from what has gone before. This includes the distribution and employment of maps, of course.

In all history, an army has made its effect felt at a particular point on the ground by concentrating its force upon that point. There had to be a concentration of men and materials in the immediate vicinity of the point. Now all that has been changed. Neither the attacker nor the defender can afford to concentrate masses of men and materials for long in one place. Such concentration would offer a rewarding target for any nuclear weapon. All points must be lightly held, in the static sense. Concentrated force can still be brought to bear, but only for short time intervals, by the provision of high mobility to all Army components.

These conditions increase the dependence of all operating elements on maps. Mobility depends on maps for cross-country movement, for road and bridge construction, and for planned concealment of all temporary concentrations. The control of widely scattered forces requires full knowledge of all communication routes. Above all, a small unit cannot operate effectively out of sight of other units without having in its possession topographic maps covering the area of operations.

The effect of dispersion, then, is a great increase in the demand for maps. At the same time, the problems of supplying the maps are complicated by dispersion. Consider the distribution problem, for instance. Each small unit requires a portfolio of maps of its immediate operating area. Being highly mobile, it may be shifted on short notice to another operating area. If it is to do any good when it gets there, it needs a new set of maps. In both the old and the new areas, it is likely to be far from any map depot, and off any direct supply route. The map depot itself, despite the large number of copies of a large number of sheets which it must stock, is a dispersed installation.

The distribution problem is matched by the problem of producing up-to-date maps in the number of sheets required. If dispersed operations are contemplated, the only safe mapping course is complete map coverage of the entire theater of operations.

These problems have not all been solved by any means. A complete solution of the distribution problem will doubtless require much innovation, perhaps to the extent of facsimile transmission of reproduction masters or even single map copies. As for the production problem, every mapping organization is investigating ways of increasing its capacity for new compilation, revision, and reproduction of maps. The Army Map Service is no exception.

MAP NEEDS FOR THE MISSILE AGE

There are partial solutions, of course. The number of maps to be produced and distributed can be greatly reduced by simply reducing the map scale. To a certain extent, a scale reduction also benefits the user, who needs complete coverage of his area with the smallest possible number of sheets.

It appears, on this basis, that the 1:25,000 map is on its way out as a standard large-scale military topographic map and will be used hereafter only in limited or special situations such as static warfare or attack of fortified positions. In the future, the largest scale at which new general coverage is provided will be 1:50,000.

It will not be possible to eliminate the 1:50,000 scale, too, however. Questioning of the various Army service schools concerned with the development of tactical concepts indicates that they all regard the 1:50,000 coverage as essential to their operations.

Each service has also expressed a requirement for maps at a 1:100,000 scale. Evidently, the newer tactical concepts of mobility and rapid armor thrusts are producing a need for fairly complete topographic maps at a more compact scale than the basic 1:50,000. This need cannot be satisfied by the medium-scale maps which the Army Map Service has been producing in large numbers. The latter maps, mainly at a scale of 1:250,000, are used primarily for planning. They are also regarded as essential by most services.

At present, very little coverage has been produced at 1:100,000. It looks as if we have a big mapping job ahead of us at that scale. Apparently, the effect of the newer

concepts is to eliminate one scale (the 1:25,000 scale) and to add one scale (at 1:100,000). This is a clear gain from the point of view of production and distribution, since a map at 1:100,000 covers the same area as sixteen maps at 1:25,000.

I have tried to give the main consequences of the trend to dispersion brought about by nuclear warheads. A few final words ought to be said about mapping requirements which are a direct consequence of the nature of nuclear attack. Operations in friendly territory must include provisions for civil defense against nuclear attack. This planning requires maps for the siting of defenses and, if the necessity should arise, for damage assessment and the plotting of fallout patterns. Special map information is also needed to permit planning which takes advantage of all terrain factors in the protection of personnel. Some of these factors can be shown on special maps. Examples of such factors are soil types, bedrock types, and vegetation classified as to its protective properties.

It ought to be clear from the foregoing that the military need for topographic maps will be larger than ever in the years ahead. The real problem that faces us is how we can possibly produce the necessary maps rapidly enough to meet any emergency. Increasing investigation will be required into ways of producing usable provisional maps under emergency conditions, and ways of greatly speeding up the production of standard-accuracy topographic maps by such means as the Army Map Service integrated mapping system and others. Above all, we must keep our mapping defenses up, with sufficient appropriations and people to make a continuing reality of the Army Map Service motto, taken from Publilius Syrus' maxim 709, enunciated in 42 B.C.: "We should provide in peace what we need in war." The maps we fight with on D-day will be those we prepared in advance.

Professional Liability Insurance Questionnaire

In the interest of seeking the best possible professional liability insurance for its practising members, the ACSM Board of Direction, at its May 16, 1959, meeting, authorized the canvassing of its membership to determine its interest in this regard. This questionnaire, mailed in August, was sent to the entire ACSM membership to be sure that all interested members were included. All members interested in the liability insurance concerned with "errors and omissions" are urged to reply promptly.

Skin Divers Aid Study of Atomic Waste Disposal

Skin diving oceanographers of the Coast and Geodetic Survey have completed monitoring of simulated packages of "radioactive waste" dumped into 97 feet of water off the New England coast. This unique oceanographic operation was carried on under contract with the Atomic Energy Commission.

Instead of real atomic materials, the packages contained a brilliant yellow dye. The Atomic Energy Commission wanted to know whether such containers break open immediately, gradually disintegrate, or are buried in the bottom.

The skin-divers went overboard from the survey vessel *Gilbert* and stationed themselves at the bottom as the dye-containing packages were dropped from the vessel. The containers were numbered for identification. These metal drums, weighing up to 1,200 pounds, were packed variously and dropped under varying current conditions. The divers, waiting on the bottom, had to be careful. Underwater "dust" created by the successive bombardment of "cans" limited vision to a few feet at times.

The diving operations were carried on over Browns Ledge, which is twelve miles west from Martha's Vineyard, Massachusetts. The team of four Coast and Geodetic Survey divers was accompanied by another diving scientist from the Fish and Wildlife Service.

The Browns Ledge studies are part of a larger project planned to find out what happens to radioactive waste dropped into the sea, so that the best disposal areas and methods can be determined.

Programming Topographic Maps for Automatic Terrain Model Construction*

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ABSTRACT: the present method of constructing terrain models at Army Map Service requires highly skilled personnel and many man-hours of manual operation. A system approach to automatic terrain model construction is described which automates the operations through the use of digital records. This program technique minimizes the basic readings and eliminates the laborious interpolative processes required by using the UNIVAC to process and expand the data that are necessary to obtain the desired topographic expression. These processed data are subsequently used to automatically control the cutting of the terrain model.

INTRODUCTION

The Army Map Service has been producing three-dimensional relief maps over the past decade. Initial work was confined to the production of plaster and papier-mache models. These models, however, were soon found to be impractical for military usage because of their weight, size, fragility, cost, and infeasibility for mass production. The introduction of sponge rubber eliminated some of these disadvantages; nevertheless, its use did not overcome the problem of hand painting or enable mass production. It was not until the application of plastics to relief maps that, for the first time, a practical product was obtained for military use.

The Korean War verified the earlier position taken by the Corps of Engineers regarding the importance of relief maps and their significance as a military tool. Their uses are many: namely, for strategic or tactical planning, training, engineering design studies, intelligence, amphibious operations, and interrogation of prisoners of war. Recently, emphasis has been placed on the use of terrain models for line of sight and missile guidance applications, thus providing an entirely new field of development for military as well as commercial usage. Other governmental organizations are or recently have been engaged in developing new equipment and techniques for model production. Some of these are the Engineer Research and Development Laboratories, Navy Photographic Interpretation Center, Navy Special Devices Center, and the Aeronautical Chart and Information Center.

PRESENT METHOD

At the present time, master terrain models are produced at the Army Map Service by initially cutting a stepped model from a block of laminated plastic sheets or a solid block of plaster. The operator, using a tracing stylus, follows a contour line which has been previously etched into a metal plate and placed upon one table of the routing machine. The motion is transferred through a two-dimensional pantograph to a router blade which cuts the same configuration in the plastic laminates or removes layers of the plaster material mounted on another table (Figure 1). The resultant stepped model is then manually carved to eliminate the stepped edges.

PREVIOUS INVESTIGATIONS

Because of the excessive time and number of operational phases required for the construction of these terrain models, work was initiated a few years ago by the Army Map Service to study the feasibility of em-

* Information contained in this paper does not necessarily represent the official views of the Corps of Engineers or the Department of the Army.

Presented at the 19th Annual Meeting of the American Congress on Surveying and Mapping, Washington, D. C., March 11–13, 1959.

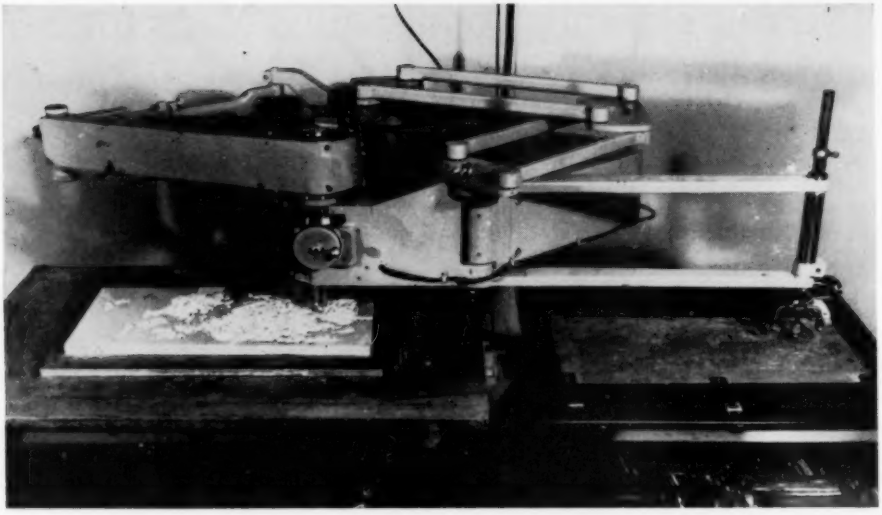

FIGURE 1.—The two-dimensional pantograph.

ploying profiling techniques to produce these models. Preliminary tests conducted by the Relief Map and Photogrammetric Divisions, utilizing a modified Wild A-5 to permit direct model carving operations, indicated that major improvements were possible and that further effort should be expended in this area[1] (Figure 2).

OBJECTIVES

Additional studies confirmed the desirability of procuring a system that would be specifically adapted for profile scanning of flat maps. It was also decided that the system should be designed to meet the following objectives: (1) be capable of materially reducing the time required to produce master terrain models—by as much as 50 percent, (2) improve the accuracy and relability of producing these models—an accuracy of ± 0.005 inch as compared to the indicated flat map positional values, (3) increase the flexibility of present model carving methods and model libraries—through use of computers and digital tape storage, (4) increase the capabilities of field units—

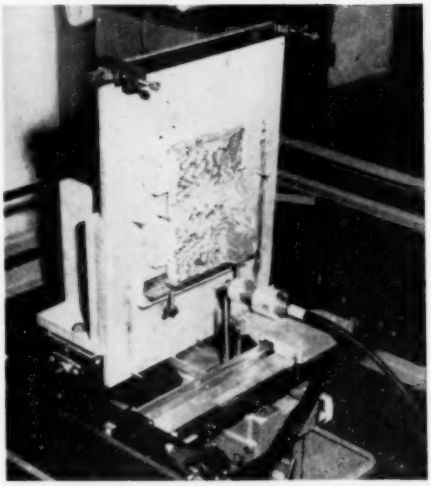

FIGURE 2.—Utilization of a Wild A-5 to rout a laminated wax block by profile scanning.

tapes of previously recorded map data be readily transported or transmitted to overseas theaters, and (5) be compatible with the AMS Integrated Mapping System[2]—be

[1] AMS Technical Development Final Report "Stereo-Carving Instrument Development," 30 November 1956.

[2] C. S. Spooner, S. W. Dossi, M. G. Misulia, "Let's Go Over the Hill," *Photogrammetric Engineering*, December 1957, pp. 909–920.

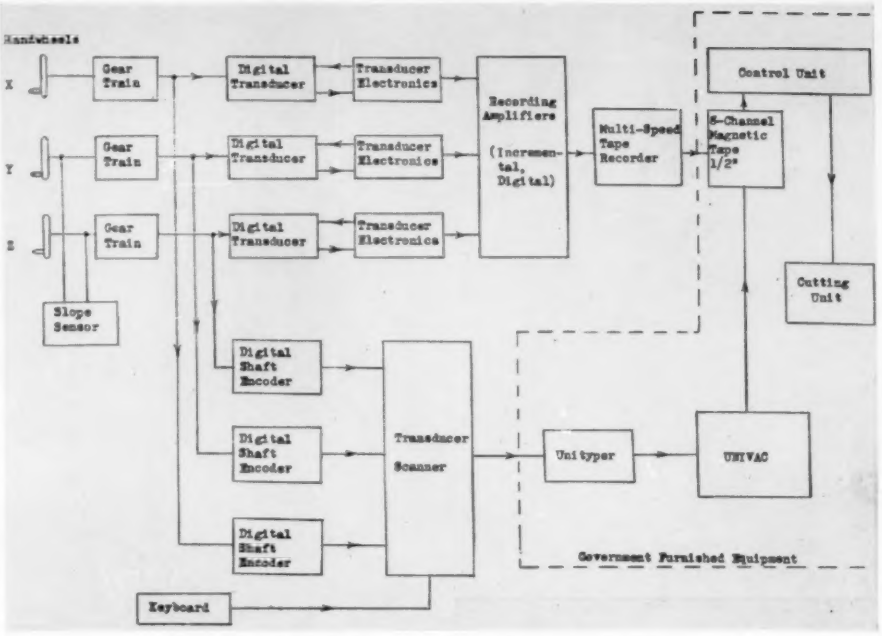

FIGURE 3.—Block diagram of Master Terrain Model Machine.

capable of accepting digitally stored profiles from stereophotogrammetric exercises.[3]

PROPOSED SYSTEM

Specifications were subsequently prepared and a contract recently awarded to Electronic Control Systems to procure a machine that consists of two basic units: (a) a scanning and recording system, and (b) a tape control unit and cutting machine for the automatic production of master terrain models (Figure 3). It is planned to perform the recording operation in two modes, in continuous incremental form for *direct* feedback to the numerically-controlled cutting machine and in form of discrete coordinates for *indirect* input utilizing the UNIVAC to perform the necessary interpolative processes (Figure 4).

Direct Interpolative Scanning. In this mode, the operator scans in successive profiles a topographic map copy positioned on a cylinder. The profile spacing is dependent upon the surface finish desired on the master terrain model. A minimum spacing of 0.001 inch is specified, the incremental positioning being accomplished by an "*X*" handwheel. The speed of rotation of the cylinder is manually controlled by a "*Y*" handwheel. The scanning console is provided with a vertical programming "*Z*" handwheel arranged so that one complete revolution represents the equivalent distance of one contour interval. The *X*, *Y*, and *Z* motions of the scanning console are instrumented by means of motion digitalizing transducers which are compatible with the magnetic tape recorder and the numerical control unit of the milling machine. In addition to a fixed scanning reference mark, a movable reticle is provided as part of an optional slope sensor unit to aid the operator in programming uniform slopes. When the fixed reference mark is located on a contour line and the movable reticle advanced to the next con-

[3] Leon J. Kosofsky, "Investigation of an Integrated Mapping System," *Photogrammetric Engineering*, June 1958, pp. 458–467.

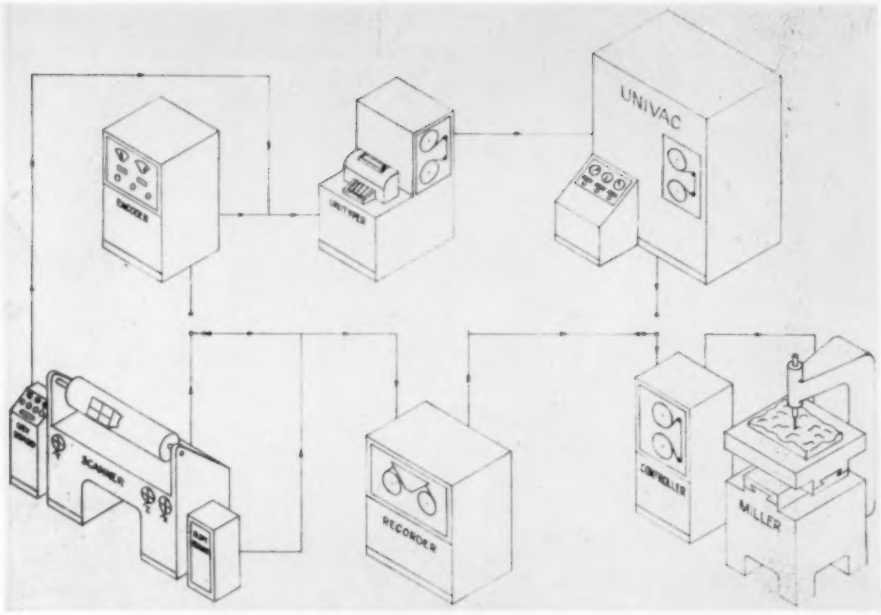

FIGURE 4.—Pictorial layout of the model carving system.

tour line, the slope sensor computes and controls the Y and Z motions to obtain the desired straight line slope. In areas of uniform slope, means are also provided for recording only every fifth contour (index contour), thus facilitating the scanning operation. The format employed for recording coordinate data onto magnetic tape is described herein under the paragraph entitled "Control Tape Format." The "canned" topographic profiles are subsequently fed directly into a control unit which automatically guides the cutting tool of the milling machine to reproduce a three-dimensional replica of the two-dimensional map previously scanned.

Indirect Scanning (A Technique for Recording Terrain Data for UNIVAC Processing). In contrast to the direct interpolative scanning method, the system allows for an indirect interpolative scanning method. The desirability of including this alternative method was primarily based upon the physical limitation of speed, operator fatigue and need for highly skilled cartographers in the direct method. The text to follow describes in detail the indirect interpolative method to be employed.

The operator by the use of the "Y" speed regulator wheel will traverse along a profile (in the y direction) until a contour line intersects the fixed reference lines on his viewing screen. At this sighting he will depress a keying device which will cause an automatic read-out of the y coordinate measure of the contour line and the associated relative contour elevation. This relative contour elevation will be chosen by the operator by the depression of the proper key; namely, a plus (+), minus (−) or same (s) key. These values denote whether the intersected contour information is one contour increment higher, lower or the same as the previously recorded contour coordinate. This operation is carried throughout the entire length of the profile scan. For example, the recorded informa-

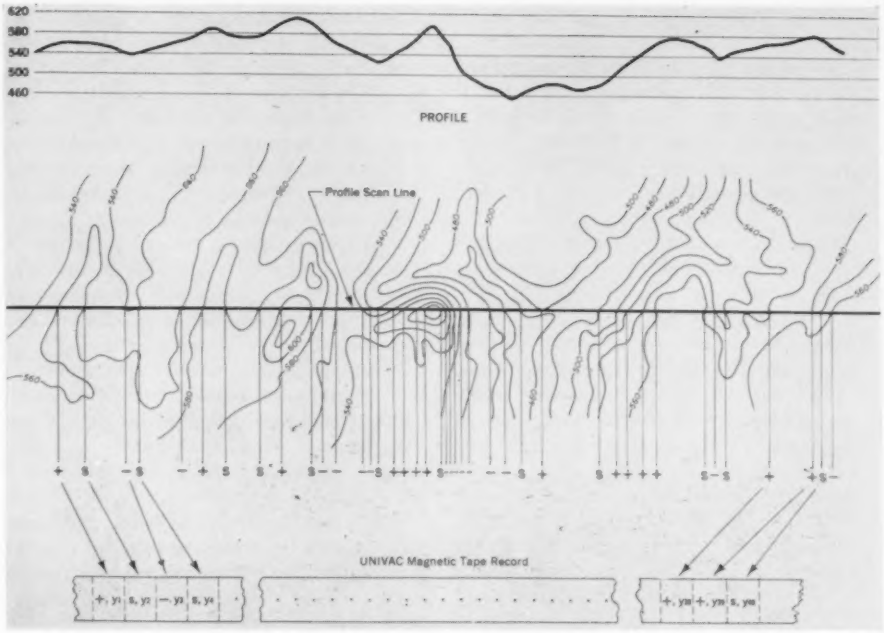

FIGURE 5.—Digitalized discrete magnetic tape record of a typical profile scan.

tion for a profile could be in the form shown in Figure 5.

In abstract, this system of recording is digitalizing the known hypsographic information of a topographic map. If the scan widths of the recording of the data were taken off fine enough, in theory it would be possible to recreate the relief information as embodied on a flat topographic map. It was realized, however, that to truly depict the terrain, more than contour information would be required. A skilled cartographer visualizes more than the abstract contour data portrayed on a topographic map. Aided by such additional information as drainage and critical elevation values, he is capable of expressing a specific pictorial representation of the ground in its true three-dimensional form. It was therefore necessary to provide instrumentation to record additional topographic information such as drainage and ridge lines to improve and facilitate the UNIVAC processing.

The following other modes of recordings are possible in the indirect scanning method:

a. Fractional contour coordinate recording. Provisions were made on the keyboard to record, at the operator's discretion, incremental contour data. For example, the format of this type of recording could be of the form + .2, which means that for the corresponding y coordinate recorded the z coordinate value is two-tenths of a contour increment above the previous z coordinate value. In this manner, drainage and ridge line information, as well as spot heights of other significant and influential land forms, can be digitalized along with the contour information.

b. The recording of only index (major) contour values. In areas of steep and uniform elevation changes, where dense packing of contour lines occurs, it would be redundant as well as physically impossible to record rapidly all the contour information. The dropping of the minor contours

would in no way affect the accuracy of the process; hence, instrumentation to record only the index contour lines was needed. Therefore, it was decided that in order to speed recording of these data, as well as eliminate redundancy, a keyboard recording device should be added which would permit the possibility of recording contour omissions. For example, the recording + 5 would indicate a relative z value of five contour increments above the previously recorded value.

c. Absolute elevation recording. There is a need for recording known height values (spot heights) as depicted on the map copy. The system as developed has been designed to accept these data as a modified entry in the scanning process or as supplementary data inserted into the UNIVAC at the time of processing. The hardware for data entry in the scanning operation will again be by keyboard instrumentation. A special key will be provided so that recording of any desired numerical data can be executed. This facilitates the recording of known height values and their corresponding y coordinates. For example, A5125.00 would denote that the z value at the point of recording (the measured y coordinate) is an absolute z coordinate of 5125 feet (or meters). The code *A* denotes that the subsequent data are absolute coordinate recordings. The unit of measure of the recordings can be preassigned.

In summary, the indirect system permits four types of recording:

a. The unit increment contour recording with reference to relative z values, namely, +, −, or s.

b. Fractional relative contour recording.

c. Contour skip count.

d. Absolute numerical height recording.

The scanning device can be constructed so that the normal recording of the relative unit incremental contour values can be performed "on the fly" with the operator depressing the proper +, −, or s key. With sufficient experience, the operator will be able to speedily profile scan by synchronizing the contour intersect of reference line on the viewing device with the touch of the proper key. The fractional, skipped, and absolute contour recordings can be executed by stopping at the desired position and depressing the proper numerical key to record and then continuing.

The hardware for recording the digitalized information will be a UNIVAC UNITYPER modified to record the digital conversion of the analogue position of a y coordinate upon activation of one of the variable z record keys. The UNITYPER is essentially a standard device developed by Remington-Rand UNIVAC which allows the typing of alpha-numeric information in the proper code format on a magnetic tape suitable for direct input in the UNIVAC. The choice of the UNITYPER was made because the output from this device required no subsidiary equipment to convert the recorded information before processing could be carried forward on the UNIVAC.

UNIVAC Processing. The scanned data on magnetic tape will then be fed directly into the UNIVAC. The final processed data placed on the output tape will be directly acceptable as control data for activating the automatic milling machine. The prime requirement of the processing step is to expand the discrete contour coordinate data so that a numerical expression of a smooth "continuous" surface can be obtained within the desired tolerance limit. We wish to develop a numerical computing process which, mathematically speaking, will produce a piece-wise continuous surface passing exactly through the known contour lines and selected spot elevations. Furthermore, to a certain degree, the system is required to produce a surface which reflects the topographic expression of the true ground form.

In developing such a computational scheme, the possibility of using elaborate mathematical surfaces which would approximate the fixing of the known values was suggested. Such techniques, however, entailed much UNIVAC processing time, with no assurance of the resultant computation yielding the desired topography.

To develop a computational process which fully utilized the speed of the UNIVAC and which also took into account its limi-

tations, the following criteria were strived for in the processing step:

1. The numerical computed surface be held as close as possible to known contours and spot heights.
2. The numerical values be computed as rapidly as possible to sufficiently define the desired surface.
3. The numerical surface generated be "smooth" between known points without discontinuities.
4. Topographic expression be inherent or developable in the computing technique.

With these criteria in mind, methods were then explored for surface computation. The first and the third criteria were fairly easy to define mathematically, but they are necessarily dependent on the second criterion, the speed of computation. Obviously the interpolation method selected would be governed by the speed criterion of the method. Hence, a technique was required to be as simple as possible, and yet within the specified accuracy limits. This basically had to be linear in expression, that is, a system of computation was required which gave a linear interpolation in both the x and y horizontal directions. The fourth criterion, concerning topographic expression, elaborated further in the text, seemed to be inherent in the linear method developed.

Before continuing with the description of the method of computation, perhaps an analogous scheme in two dimensions will clarify the expressibility of the technique in three dimensions. Take, for example, the following problem:

Given two points, $x = 0$, $y = 0$ and $x = 5$, $y = 5$; compute the y (or height) values for the intermediate points $x = 1$, 2, 3 and 4. Obviously the normal technique for linear interpolation would be to compute the differences of the two end points and apply a ratio of the difference to the point in question to obtain its value. A more indirect method of obtaining the unknown values is to set up a set of difference equations which expresses the relationship between the points in the interior. Thus, let us call the unknown points y_1, y_2, y_3, and y_4 and state the general difference equation as

$$y_i - y_{i-1} = y_{i+1} - y_i$$

or

$$y_i = \frac{y_{i+1} + y_{i-1}}{2}$$

Using the figures previously given we obtain the following:

$$y_1 = \frac{y_2 + 0}{2}$$

$$y_2 = \frac{y_1 + y_3}{2}$$

$$y_3 = \frac{y_2 + y_4}{2}$$

$$y_4 = \frac{y_3 + 5}{2}$$

The above set of equations can be solved directly for a solution, however, an iterative technique for computation can be carried out which will converge as close to the exact value as a function of the number of iterations carried out.

Essentially, the technique developed for the UNIVAC is based on a similar principle. A difference equation was developed to express the linearity of the surface about a local point in question. In general terms, for a three-dimensional surface, the linear difference equation is expressed as $Z_{i,j} = (Z_{i,j-1} + Z_{i-1,j} + Z_{i+1,j} + Z_{i,j+1}) \div 4$. The value of the point in question is equal to the average of its four closest neighboring points.

The method used to determine the number of points to compute is to figuratively lay a grid on the topographic map as shown on Figure 6. The grid size will be such that the known contour lines can be shifted to the nearest mesh point without materially affecting its general configuration. Those mesh points not occupied by the assignment of a contour value will be the unknowns to compute. It can be seen that this technique will develop an intermeshed system of difference equations which will express the linear surface of the area between contour lines and spot elevations and that the dips and the bulges appearing in the contour lines will effectively influence the numerical values being computed. Here again the computation is carried on by iteration until the desired convergence is obtained.

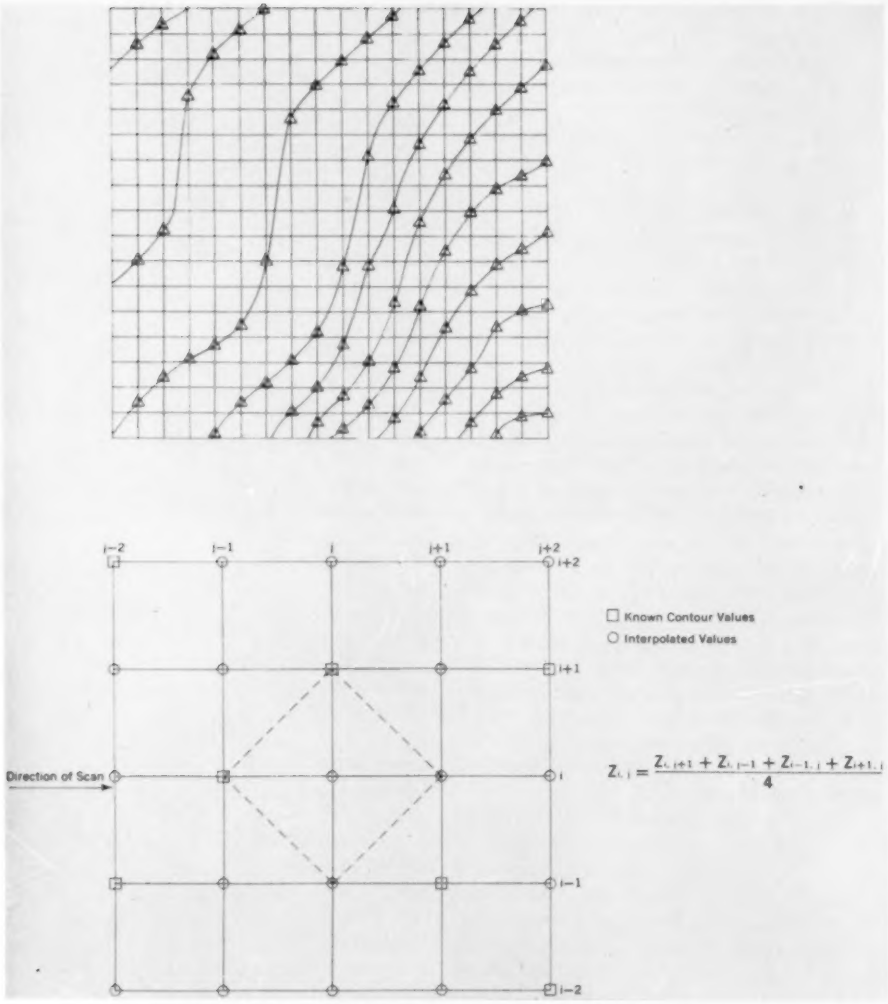

FIGURE 6.—UNIVAC numerical adjustment technique.

In detail the UNIVAC step by step processing is as follows:

1. The initial recorded discrete relative contour data will be scanned for consistency and corrected if an error is detected by noting the inconsistencies in the scanned information. One method of observing the correctness of the data would be by aligning adjacent scans. Since the scan lines give a picture of the profile of the terrain, it is necessary that there be a close alignment of the data recorded. Another method would be to estimate the elevation of the map sheet corners and either record or insert their values into the UNIVAC as subsidiary information; the data can be checked for convergence to these corner values. (Characteristic data error indications simi-

larly arise during the computing process.) Other consistency checks can also be made on the input data.

2. The relative height information will be converted to absolute numerical data in accordance with the map scale parameters inserted. Namely, the +, – and s information will be assigned a true elevation.

3. The UNIVAC next will lay a grid system according to the specified accuracy requirement of the final terrain model to be cut. These subsidiary data will be inserted into the UNIVAC at the time of processing.

The recorded contour line data and spot elevations in this process can either be rectified to the nearest mesh point in the grid system, if it does not fall on a mesh point, or its neighboring grid points can be mathematically assigned an estimated correction value.

The UNIVAC process is now ready to compute the elevation of all the unassigned mesh points of the grid system.

4. In order to perform the interpolation by use of the difference equations, mentioned above, an initial assignment must be made to the points to be computed. This will be done in one direction by the normal linear assignment. In this case, since the data will be sequentially recorded in the y profile direction, it will be a y linear interpolation. This initial interpolation step will essentially define all the points in the grid system.

5. After the first approximation, UNIVAC will rescan the points in the grid system and adjust the values of these points using the difference equations previously described. This will change the values of the linear profile interpolation and introduce the influence of the adjoining profiles. Thus, the data will be processed for the entire map sheet on a single go around.

6. If a point changes in the computation beyond a specified limit (the limit being defined by the desired accuracy of the end product), UNIVAC will be instructed to repeat the above step and reprocess the data a second time. The data will be then recomputed using the interwoven difference equation. If a change in value or values once again exceeds the limit specified, a third iteration will be performed, etc. The iterations will be carried on until the change detected in the computed value is under the limit specified. The numerical computation of the map sheet will be completed when the mesh points give a numerical definition of a smooth surface.

7. If scale exaggeration or spherical map sections are required in the model to be carved, the UNIVAC will reprocess the numerical data through a transformation formula to obtain the desired scale exaggeration or adjust the numerical data by applying the proper mathematical expression to transform the elevation reference from a flat datum to a spherical datum.

8. The last process required by UNIVAC, before the output tape can be played back on the automatic milling machine control, is the generation of the proper data format acceptable to the carving machine. This will be described in the next section.

Figure 7 shows, on a very large scale, the adjusted profiles computed by UNIVAC. The dark lines indicate the discrete contour data recorded by the operator. The intersection of the other lines shows the result of the smoothing process executed by the described computing technique.

Control Tape Format. The process output for the system will be a magnetic tape record with an information format that will be directly acceptable for directing the control of the cutting tool. The format required for control is a binary incremental tape whereby the control of the recorded binary configuration, fed into the cutter control, will direct the motion of the cutting tool. The technique used to control the automatic milling machine is to assign specific channels on the magnetic tape to control the motions required in the Cartesian coordinates x, y, and z. A channel is assigned for the $+x$, $-x$, $+y$, $-y$, $+z$ and $-z$ motions. A pulse assignment, generally speaking, controls the movement of 0.001 inch of the tool in an incremental direction. Using this scheme of directional data recording, the device is able to control the cutting slope from point to point. For instance, if the desired motion is to perform a linear cut between two points, where the

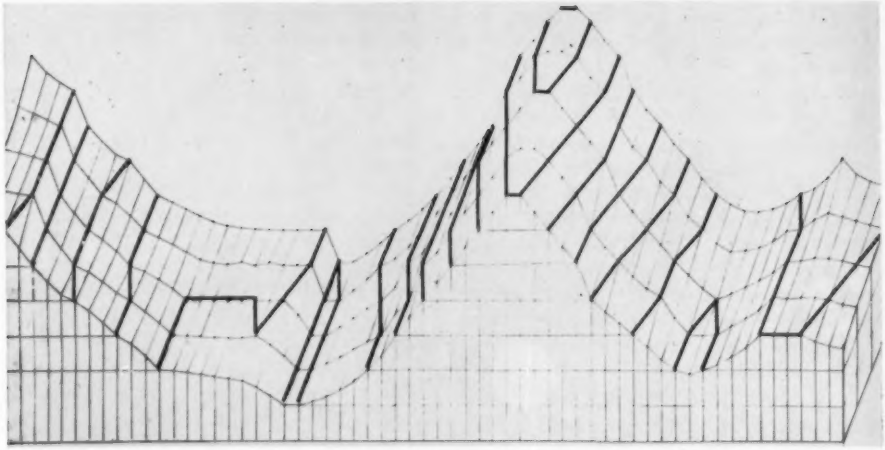

FIGURE 7.—An example of adjusted profiles computed by UNIVAC.

y values are 0.01 inch apart and have a rise in z of 0.005 inch, the data will appear as illustrated in Figure 8.

A question arises as to how the technique described will necessarily yield a truly straight slope. If the device can precisely control the tool movement, then the cut would describe a zig-zag pattern, in discrete steps from pulse to pulse. Instrumentation of the device, however, is such that a servo lag occurs in which the "seek and balance" time of the servo mechanism essentially smoothes the cut to nearly a straight slope.

The direct scanning method produces the control tape directly during the scanning phase. In this mode the binary pulse pattern is generated in accordance with the motions of the coordinate handwheels manipulated by the operator.

The final process of the UNIVAC will be the production of the previously described binary incremental controlled tape. The numerical quantities produced by UNIVAC in the computation step will be translated into the proper control language by a point to point method. In essence, a linear connection is made in the profile between the mesh points of the grid system generated in the computing step.

Discussion of UNIVAC Simulation Technique. The criteria for the accuracy of the UNIVAC simulation system should be compared to the direct interpolation method. In a sense this can only be an empirical judgment. The height of a point between

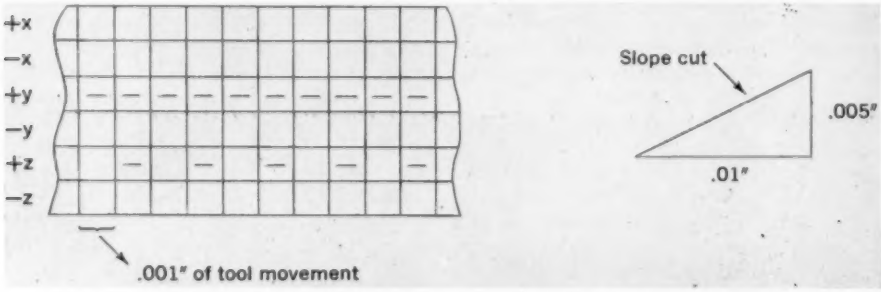

FIGURE 8.—Typical binary incremental control tape format.

known contour lines or spot heights is only measurable from a subjective sense. An elevation of a position given from the contour line on a flat map is greater than the lowest of the two contour lines and less than the higher of the two. However, there can be extracted from a topographic map certain closer estimates of the height of the point in question by assuming certain criteria of the rise and fall of the land formation. Specifically, the following criteria can be applied in the majority of cases with the assurance that the range of the guess has been narrowed to obtain a closer measure of the height of the point in question:

1. That there is a certain smoothness in the transition of the ground from one contour to the next.

2. That the rate of increase of the rise and fall of the ground is a function of the gradient change of the adjoining contour areas. The steepness of the rise or fall of the ground affects the steepness of the next intercontour area.

3. That the drainage lines as well as ridge lines are extendable from one intercontour area to another intercontour area by the shape of the known contour lines.

The UNIVAC system is primarily limited to the first criterion, with the second criterion coming into play on the assumption that the intercontour regions are such that the influence of the gradient change is reflected in the data recorded. A UNIVAC computing system to take direct account of the second criterion was and still is being investigated at the present time. The mathematics to embrace this criterion is simply a variation of the present technique developed, namely, it is that any mesh point, whether it be a known measured point or not, be equal to the average of its four nearest neighboring points. This means that if a mesh point is a known contour value, its value must be equal to the average of its neighbors. A numerical conflict arises since it is a known point and cannot be changed; however, its equation can be expressed in the form that the four neighboring points are equal to four times the known contour value. For this entire linear system there are more equations than unknowns and these equations can be solved only by the application of some principle, such as least squares, to resolve this difference. Since we are now dealing with a direct system for solving the unknown values, we are faced with the problem of computing as well as setting up other equations than the original simple difference equation, namely, a set of normal equations. The time required to solve the number of unknowns in a system of the magnitude posed by this type of problem is prohibitive for a computer of the size of UNIVAC and would even tax more recent solid-state computers. This is not to say that possibly other avenues do not exist to take into account the effect of the second criterion.

It can only be said that UNIVAC has learned only the basic rudiments of how to give the touch of topographic expression; however, if this word "expression" can be abstracted, the UNIVAC can be made to produce something perhaps close to it. As a final remark on the subject of simulation, it is felt that the UNIVAC system can produce a terrain model at least as good as, and perhaps more consistent than, the product turned out by the direct interpolative scanning method. This consistency will undoubtedly be readily noted during the marriage phases of adjacent models. This observation is partially based upon the practical consideration of the speed of operation, operator fatigue, and other physical conditions surrounding the direct use of a human in the direct method.

Advantages. The indicated advantages of the proposed model carving system are: (a) Nominally inexpensive programming components are required, (b) programming may be done by dispersed field offices and field units, (c) programming may be done prior to need of physical specimens, (d) a topographic map may be programmed by a number of operators, (e) scale and spherical transformations may be readily accomplished, (f) permits adjustments to fit original survey and triangulated control, (g) computer may be used to perform interpolative processes, thus permitting use of semiskilled personnel, (h) ideal storage medium for model library, (i) eliminates

need for redundant scans to perform rough cuts, (j) reduction of operator fatigue, (k) consistency of results maintained among operators, (l) permits map orientation to optimize scanning operations, (m) permits adjustment of function lines prior to cutting operation, (n) standard commercial tape control unit available, (o) system may be readily convertible to accommodate automatic scanning devices, (p) compatible with the Integrated Mapping System—can thus obtain 3-D specimens from stereophotogrammetric sources.

Disadvantages. The following disadvantages of the proposed model carving system are indicated: (a) Tie-up of an expensive general-purpose computer, (b) topographic expression may suffer; the degree of misinterpretation, however, will only be indicated after additional experience has been gained, (c) more expensive instrumentation required; this will be offset to some extent since only one milling machine will be required to handle the product of a number of programming units, (d) need to retrain operators skilled in contour following to learn an unfamiliar interpolative, profile scanning process. The indirect computer approach, however, should minimize this requirement since the operation only requires that the operator determine whether a contour line is above or below the previously scanned contour.

FUTURE PLANS AND PROSPECTS

Based upon preliminary tests and theoretical studies, means with which the project objectives are to be met have been cited. Full exploitation of the operational benefits to be accrued from the proposed system must await actual performance testing and evaluation.

Upon receipt of the contracted hardware, expected by the Spring of 1960, operational tests shall be initiated by the Relief Map Division, Army Map Service. Concurrently, a UNIVAC program is to be developed and made available during the initial phases of these tests. It is envisioned that preprogramming techniques, such as layer tints, will be developed to facilitate the interpolation processes. Results of these tests shall be forthcoming in a future report.

The decision to procure the specified hardware was primarily based upon the availability of standard commercial equipment and the immediate need for rapid production of accurate terrain models. It is recognized that the optimum system would be the complete automation of the scanning, recording, and cutting phases. Automation of the cutting phase has already been achieved; consequently, further development effort should be directed toward improving the scanning and recording operations. One possibility concerns the automatic scanning of a topographic map along contour lines, using a line sensing device which will simultaneously record the x, y coordinates of each contour. The data could then be transformed into y, z profile information which would be used to drive a milling unit. Another approach relates to incorporating a sensor which automatically reads out contour line crossings along a profile.[4] Analogue simulation techniques employing difference of potentials between contour levels established on a programmed format also appear worthy of consideration. A probe could then be used to rapidly scan and record the simulated terrain model in digital form.[5]

It is hoped that the disclosure of the proposed system will germinate other design philosophies from which more efficient methods for producing master terrain models will evolve.

[4] Engineer Research and Development Laboratories Contract with Kaiser Aircraft & Electronics.

[5] Navy Special Devices Center Contract with Technitrol Engineering Co.

IT IS NOT TOO EARLY TO BEGIN PLANNING
TO ATTEND THE 1960 MEETINGS

Ephemeris Time and Universal Time

By DONALD A. RICE

COAST AND GEODETIC SURVEY

MANY geodetic astronomers and surveyors, having already seen the 1960 edition of the *American Ephemeris and Nautical Almanac,* are wondering about the new term, Ephemeris Time (E.T.), used as the argument in the ephemerides of the sun, moon, and planets. Underlying this fundamental change is an interesting story on the refinement of accurate time keeping. Although the matter has been thoroughly discussed in various scientific journals, it was thought that a brief review would be of interest to geodesists and surveyors, and also that this would be an appropriate occasion to review some relations between time, the various ephemerides, and the conventional methods of field astronomy.

Time is measured and recorded by clocks of many varieties. Manmade clocks have the normal function of counting a series of recurrent events, the recurrence frequency being controlled by some built-in mechanism. The balance wheel of a watch and a swinging pendulum are familiar examples. All manmade clocks have two common failings if time must be carried over a long interval—the frequency rate is more or less variable, and the clocks are subject to stoppage. Even the most refined quartz-crystal clocks fall far short of the ideal in these respects. The natural clocks available to astronomers are certainly not subject to stoppage, but what about uniformity? The answer depends on the kind of motion that governs the celestial clock rate.

Until recent years the rotational period of the earth was accepted as the absolute standard of time. Observatory clocks were continuously regulated by astronomic determinations, essentially the counting of intervals and fractions of intervals between successive passages of a given star over the local meridian. A clock so regulated provides a faithful record of earth-rotation, or sidereal, time. It should be noted here that mean solar time is rigidly connected to sidereal time by formula, and thus the two are equivalent as far as uniformity is concerned. The time scale derived from these measurements is called Universal Time (U.T.). At any given epoch, a Universal Time interval can be measured to as high an accuracy as might be desired, but only with respect to the earth's rotational period as a standard. As the period changes, so precisely does the measure of Universal Time. It is now known that the earth's rotational motion is subject to periodic, secular, and irregular changes; and these are serious enough to render U.T. unsatisfactory as an absolute standard.

The orbital motions of celestial bodies under the law of universal gravitation are extremely complex, due to interaction between the various bodies. Nevertheless the difficulties are mathematical ones—there are no unknown forces of the kind that degrade the uniformity of the earth's rotational motion. Over the past century or so, by the most intense effort, a few dedicated astronomers have developed equations to express the orbital motions of the celestial bodies of the solar system as a function of time. Two principal examples are the motions of the moon about the earth and of the earth about the sun.

To an observer on the earth, the sun and the moon appear as separate clock hands in the sky; a time measurement consists in determining either of their angular positions with respect to the star background. One quickly notices a limitation in this type of clock as compared to the earth-rotation clock. The moon, most time-sensitive of the orbital-motion clocks, is only 1/27th as sensitive as the earth-rotation clock. The sun clock is still less sensitive, by another factor of about 13. This disadvantage is no longer of great concern to astronomers

because there are instruments such as the Markowitz moon camera and related techniques which will give the moon's position among the stars with adequate angular precision, provided the measured time interval is of the order of months or years rather than days. By a further step the moon clock is then related to the slower-moving sun clock, the latter having been agreed upon as the keeper of uniform astronomic time.

The Tables of the Sun, compiled by Simon Newcomb late in the 19th Century, express the celestial mean longitude of the sun (its angular position among the stars) as a quadratic function of time. Except for certain periodic terms which can readily be calculated, it may be assumed that the Newcomb formula reflects the laws of motion of the sun exactly in terms of an absolute time unit, the Ephemeris second. Consequently, the measure of any given interval of Ephemeris Time is that number of Ephemeris seconds, as applied in the Newcomb formula, that will give the change in the sun's celestial longitude actually observed for the interval. In the future there may be developed slightly more refined theories of lunar and solar motion, with corresponding small changes in definition of the Ephemeris second. It is currently defined as "the fraction 1/31,556,925.9747 of the tropical year for 12^h E.T. of January 0, 1900." In effect, the above definition provides a clear-cut time interval for application to the Newcomb formula, and gives a fundamental epoch to the Ephemeris Time scale. Also, the length of any other tropical year is related to that of 1900 by a rigid formula, permitting precise transfer of the time scale to another observing period. In 1903 Ephemeris Time and Universal Time were essentially coincident, with E.T. gaining about 1.5 seconds per year on U.T. Since then the relative rate has varied considerably, reducing to zero about 1935 and followed by another gain for E.T. in later years. At present, E.T. is about 34 seconds fast on U.T.

The recent development of molecular and atomic frequency standards enables an independent approach to the problem of absolute time. The vibration frequency of a cesiun atom, for example, can be continuously compared with a quartz clock which then in principle becomes a standard of atomic time. Whether the atomic and astronomic standards will continue to agree over a long interval remains to be seen. The comparison will have fundamental bearing of physical theory and the character of the universe.

Users of ephemerides for conventional field astronomy will naturally want to know what to do about Ephemeris Time in carrying on their work. The simplest and best procedure is to avoid using any ephemeris with E.T. as the argument. A little reflection will show the reasons for this. Time enters field astronomy in two different ways. First, one must use the date and time as arguments in looking up right ascension and declination in an ephemeris. As these are slowly varying quantities, the time element is not highly critical and Universal Time can be employed without difficulty. Obviously, time does enter astronomic calculations critically in fixing local hour angle of a celestial body at the instant of observation. As local hour angle follows exactly the rotation speed of the earth, it is quite easily seen that here again U.T. is the right kind of time to use. Universal Time will continue to be furnished by the national observatories for regulation of clocks, and radio time signals will continue to be monitored in terms of this unit.

In the most precise field astronomy it is necessary to consider certain other factors arising from recent refinements in measuring Universal Time. When U.T. is determined by star observations, the measurements are affected by slight deviations in the position of the instantaneous rotation axis with respect to the mean axis of the earth. Furthermore, there is known to be a periodic seasonal variation in length of the mean solar day. Astronomers at the various national observatories by mutual agreement now adjust their U.T. observations for these two irregularities, and furnish time signal corrections in terms of three systems: U.T.0 (as observed); U.T.1 (corrected for polar variation); and U.T.2

(corrected for polar and seasonal variations). In first-order astronomic longitude work the customary procedure is simply to employ U.T.0 throughout. The result is then the correct longitude difference between the field station and the national observatory furnishing the U.T.0 time signal correction, as referred to the instantaneous position of the poles for the date of observation. When definitive polar variation data become available after a period of years, the longitude difference can, if desired, readily be reduced to the mean pole by applying appropriate longitude shifts to both the observatory and field station. It is important to recognize that the deviations of U.T. from an absolute time scale have no real significance in astronomic longitude measurements since, in effect, the measurements at the national observatory and field station are made within a few hours of each other. Also, it should be emphasized that U.T.2, as defined above, is by no means intended to be an approximation to Ephemeris Time. Although the annual periodic variations in the earth's rotational motion are to a large extent removed, the irregular and secular effects are not.

The discussion has thus far avoided reference to certain geodetic techniques which involve fixing the position of a natural or artificial satellite against the star background. If the observed body is at a reasonably small distance, the parallactic effect can be employed to determine the observer's position on the earth without regard to a gravity reference. Important examples are star occultations by the moon, Markowitz moon camera observations, and the recently-developed techniques employing artificial satellites. It can readily be seen that these observations are related to both varieties of time previously discussed. The ephemeris of the orbiting body is computed on Ephemeris Time and the observing station rotates about the earth's axis on Universal Time so that, in one way or another, the methods of reduction necessarily involve a mixture of the two systems. If the celestial observations are referred solely to the local gravity plumb line, as is the case in conventional field astronomy, U.T. is the appropriate time measure.

It was previously mentioned that the *American Ephemeris and Nautical Almanac* will, beginning in 1960, employ E.T. in the ephemerides of the sun, moon, and planets. It has now been unified with the *Astronomical Ephemeris,* published by H. M. Nautical Almanac Office, Royal Greenwich Observatory. The two publications are identical as to content, but printed separately in the two countries. This volume has evolved into an emphemeris of the solar system and is no longer intended for the usual field astronomy applications. With one exception, all necessary data are available to the field astronomer in other publications. *The American Ephemeris and Nautical Almanac* will remain the most convenient source of the Besselian and Independent Day Numbers, employed in calculating apparent places of stars listed in the Boss General Catalogue.

There are listed below the three Universal Time ephemerides now available to the American field astronomer; usually some one of these will be found entirely adequate for a particular class of observations:

The Ephemeris of the Sun, Polaris and Other Selected Stars, is published annually by the Bureau of Land Management, U. S. Department of the Interior, and available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.—Price 30 cents. This publication is designed for use in determination of time, latitude, and azimuth for cadastral survey purposes. Approximate apparent places are given for 28 of the brighter stars. The terms "Civil Date" and "Mean Time" as employed in the ephemeris are consistent with the Universal Time basis previously described.

The Star Almanac for Land Surveyors, is prepared annually by H. M. Nautical Almanac Office and published by Her Majesty's Stationery Office, London. It can be obtained from the British Information Service, 45 Rockefeller Plaza, New York 20, N. Y. at a current price of 81 cents, plus 5 cents postage. This ephemeris, perhaps not well known to many

American surveyors, is fully suitable for medium-accuracy observations on the sun and stars. The sun tables give declination to the nearest 0.1 minute of arc and Greenwich Hour Angle to the nearest 0.1 second of time. The star tables are compiled for 650 stars brighter than magnitude 4.5, and give apparent places to 1″ in declination and 0.1 second in right ascension. Also included are a table for conversion from U.T. to sidereal time and a polaris table for latitude and azimuth observations. This latter table is the one that has been adopted for the 1960 revision of the *American Ephemeris and Nautical Almanac*. The *Star Almanac* contains much auxiliary information and a convenient refraction table which provides for inclusion of observed temperature and pressure.

For more precise astronomic observations the *Apparent Places of Fundamental Stars* will continue to provide ephemeris data for 1535 stars in the fundamental FK3 system. Apparent places are given at ten-day intervals, the declinations to the nearest 0.″01 and the right ascension to the nearest 0.001 second of time. This ephemeris has been published annually for the past 19 years by H. M. Stationery Office, London, under the auspices of the International Astronomical Union. Beginning with the 1960 issue, it will be produced by Astronomisches Rechen-Institut, Heidelberg, and published by Verlag G. Braun, Karlsruhe, Germany, at a current price of D-Mark 25 (approximately $6.25). It should be obtainable through local booksellers.

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The Role of Map Information in Cartography

By LYMAN D. LYNN

COAST AND GEODETIC SURVEY

THE TERM "map information" clings to the ear as do many phrases of recent coinage. An easy definition of map information is not possible. The concept is relatively new but the function has taken years to develop, and it presently consists of so many seemingly incongruous elements that it defies a simple, one-sentence description.

The present discussion is confined to the development of the map information function as employed by the various agencies of the Federal Government engaged in the compilation and publication of maps of all kinds for the benefit of the public. At least one of these agencies is authorized by law to organize and undertake the map information function and thereby has been granted a substantial personnel to implement the function. No investigation has been undertaken to determine the extent to which the map information activity has been developed by commercial mapping agencies. The obvious conclusion is, however, that some organized effort has been established for the purpose of accumulating the source material necessary for production of the maps which they publish and sell to the public.

The foregoing statement highlights the prime function of map information—namely, the accumulation of source material needed for the compilation of maps and charts. The ideal is to provide the working cartographers with a centralized, accessible file to include such material.

The question arises—What comparison may be made between the functions of map information and the map library? The answer is that they are not comparable. The map library serves a highly important and most desirable purpose in that its duty is to preserve and make available maps and charts needed by the public for research and comparison, examples of cartographic expression representative of the myriad stages of the development of the art, as well as modern examples for ordinary reference purposes. Fortunately excellent leadership in this field has resulted in the establishment of many fine map libraries throughout the world. Those existing in the United States and Canada were recently listed in a comprehensive directory compiled by Marie C. Goodman, and published by the Special Libraries Association.

On the other hand the map information function is the servant of the technician. While the map information specialist does not wholly ignore the cartography which is primarily of historical value, he places emphasis on what is new and reliable. He conducts a constant research for whatever information may be currently available for the use of cartographers in the never-ending task of compilation and recompilation of maps and charts in order to maintain their functional purposes at a high level of accuracy.

Much source material, of course, is derived from original field surveys which remain the foundation of reliable cartographic applications. In certain cases the map information organization exercises some control over this type of source material. Field surveys, however, are notably limited in extent and frequency, primarily because of the rather limited financial provisions made for mapping purposes at all levels of government. An appalling amount of area, not only throughout the world, but in our own United States remains unsurveyed. Yet certain agencies are charged by law with providing map and chart coverage, vital to the needs of commerce and industry, for the entire area.

Furthermore the picture of the earth undergoes constant change. The never ceas-

ing influence of the elements and the restless development of surface features by the works of man keep the landscape in a state of flux. Basic field surveys of interior areas made fifty or a hundred years ago may retain validity so far as topographic features are concerned, but maps produced on the basis of those surveys may be totally obsolete from the standpoint of cultural data.

One of the most unstable features from the standpoint of cartography is the coastline. The seas erode and they cause accretion. A severe storm may close an inlet overnight. A river flood may create a new delta in a matter of days. If field surveys are not available to encompass these changes, information for changing the charts or maps must come from another source. Here, map information assumes its role.

The role of map information might best be explained by describing an example of such an organization which, within little more than a decade, has been developed by one of the great surveying and mapping agencies of the Government, the Coast and Geodetic Survey of the United States Department of Commerce. There is no attempt to overlook similar development in other mapping agencies but the author has selected the one with which he is most familiar.

For one hundred and fifty years the Coast and Geodetic Survey has been engaged in the surveying and charting of the coastal areas of the United States and possessions. For approximately eighty years precise geodetic surveys have been carried on in the interior of those areas. Some thirty years ago the task was initiated of producing aeronautical charts for use in air navigation.

Before World War II these functions were supported to some extent by a map library of limited scope and function long established in the Bureau. Nevertheless individual cartographers were required to accomplish necessary source material research on an individual basis and acquire, by whatever means they could devise, the basic data required for each separate map compilation assignment. There was no central file of adequate, well-evaluated source material which could be made immediately available.

World War II, as is well known, brought about a complete upheaval in the field of mapping. The nation soon realized that it was caught lamentably short with regard to cartographic resources both local and worldwide. The frantic effort to overcome this deficiency called for unprecedented measures and hastily recruited and trained manpower. The scramble for source material assumed panic proportions. From this grew the concept of a central collection of essential material to service compilation needs.

The lesson learned during the desperate war years resulted in the postwar era in a new organization in the Coast and Geodetic Survey at first known as the Geographic Branch of the Chart Division. The Branch components included a unit devoted exclusively to the collection and dissemination of source material and another unit designed for the critical evaluation of the material acquired. This meant that the individual cartographer was no longer thrown upon his own resources for basic material. Another component of the Branch dealt solely with the problem of geographic names. This was a function which had been carried on in the Chart Division for many years, but which, with the wider scope of mapping during the war, was seen to be most vexatious. A fourth component was a special drafting section to which were assigned miscellaneous tasks which could not be readily undertaken elsewhere.

Creation of the Branch resulted in immediate improvement in the procurement of source material in support of Bureau cartographic activities, the centralization of responsibility for the coordination of cartographic services to both field and office functions, and the effective dissemination of map information.

The basic organization remained essentially the same for almost ten years until the recognition of its wide responsibility and effective functioning won it the status

of a Division. At that time the Technical Services Division, as it is now known, was given administrative supervision of the Bureau's library. An additional section was organized to handle the visual aids requirements of the Bureau including official photographs, motion picture films, and exhibit material.

Under the new organization the map information component continues its basic functions which are to acquire source material wherever available; to maintain the files of such and to effect its efficient and prompt dissemination to those having need for it; to discard superseded or otherwise worthless material; and to afford personal service to any and all individuals in need of the resources of the Section. An ever increasing task of the Section is to respond, by correspondence, to inquiries from the general public, educational institutions, and other agencies on matters pertaining to maps, geography, and related questions.

This general function is notable for its absence of routine except for certain details of processing incoming material. Not a day passes without new and different problems—many of them without precedent for action.

Recent years have seen a phenomenal increase in the number of maps, especially topographic, produced by other agencies. Such maps are the vital core of source material used in the compilation, especially of aeronautical charts. Arrangements have been made to receive periodic automatic deliveries of printed maps. Meanwhile advance proof copies of these maps are received as soon as they are at the stage where they can be reproduced in limited quantity by various methods. This insures that the information will be in the hands of the compilers as soon as it become available. In much the same way the Map Information Section receives the results of surveys made in rivers and harbors by the Corps of Engineers. This information is used principally by the nautical chart compilers. The Map Information Section has custodial and issuing responsibility for this extensive file.

The purpose of this paper has been to point out that map information, while a relatively new development in the field of cartography, has assumed a highly important role and shown indications of broader development.

Manhattan College Camp Aids in Search

A tragedy occurred in one of the wildest and most rugged sections of the Catskill Mountains on June 13, 1959, when David Raleigh, the five year old son of Mr. & Mrs. Stewart Raleigh of Fayetteville, N. Y., disappeared in the 200-foot stretch between the dock and the hunting lodge at which the family was staying.

A threatening storm had forced the father, David, and his sister, Susan, 10, in from a fishing expedition. David was set out on the small dock and told to run for the cabin while the others beached and secured the boat. Upon their arrival at the cabin they found that the boy had disappeared. No one has seen him since his sister saw him walking toward the cabin.

Search was begun immediately and continued, using skin divers, a glass bottomed boat, bloodhounds, and more and more men until, on June 17th a mass hunt of at least 600 men was organized. This large group included a contingent of slightly over 100 men, faculty and students, from the Manhattan College Camp then in operation at St. Josephs, Sullivan County, N. Y. This group, led by ACSM member Brother B. Austin Barry, was transported in two large buses to the scene of the tragedy, the vicinity of the Winnisook Club, Inc., Oliverea, Ulster Co., N. Y., to join in the wide ranging search.

These men endured a most miserable day of rainy weather, climbing over boulders and fallen timber on very steep slopes, in a vain effort to find at least some clue to the whereabouts of the lost boy. The men, many of whom had never before encountered such rough terrain, were complimented, by the authorities in charge of the search, for their strict compliance with instructions and their very real help to the general search effort.

Hope of finding the boy alive dwindled as the days passed, and at the time the Manhattan Camp closed on June 27th no clue had been found which might help to explain this very strange disappearance.

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The K. U. Carto-Compiler

By GEORGE F. JENKS

DEPARTMENT OF GEOGRAPHY, UNIVERSITY OF KANSAS

The cartographer is constantly faced with the problem of scale differences in source materials when compiling a map. This is especially true in the compilation of small- and medium-scale, special-purpose maps, where a multitude of sources are available and the cartographer may select one source for political boundaries, another for roads, and still others for railroads, physical features, etc. Scale differences are also a problem when evaluating or comparing maps, e.g., one may find it necessary or desirable to compare boundary lines delimiting patterns on vegetation, land-use, soils, geology, population or other maps. In addition, base maps of a desirable scale are often not available and must be either enlarged or reduced to suit the map problem at hand.

Changes in map scale are usually achieved by use of one of the following methods; similar squares, proportional dividers, pantograph, or photography. All of these methods have been used satisfactorily by cartographers for years, but each has certain limitations in time, accuracy, or expense. The use of similar squares, proportional dividers, and pantograph are especially wasteful from the point of view of time and often leave much to be desired in obtaining accurate results. Photographic changes in map scale are more accurate than the other methods but also

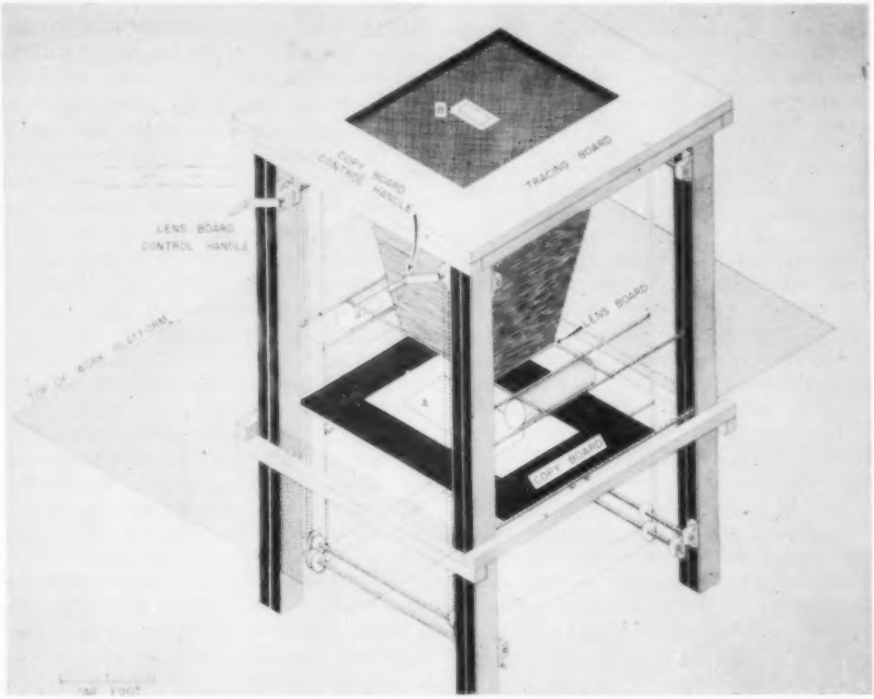


FIGURE 1.—The K. U. Carto-Compiler.

more expensive and often time consuming, since many cartographers do not have the necessary equipment and must take the source maps to a special shop and wait for film or photostat processing.

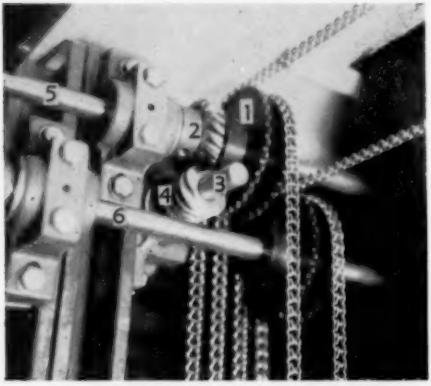


FIGURE 2.—Close-up view of the copy-board drive gears. The copy board is moved up and down by turning the copy-board control handle attached to shaft 3, which turns worm 4, activating worm gear 2, rotating shaft 5, and turning sprockets at 1. The copy-board assembly is attached to the vertical chain running downward from the right sprocket at 1. The other sprocket at 1 carries a continuous chain which crosses (horizontally under the tracing board) and moves downward at the opposite side of the instrument (*See* Fig. 1). The set of sprockets on shaft 6 are activated by the lens-board control handle and move the lens board up and down.

The K. U. Carto-Compiler was designed to give our small cartographic laboratory a low cost, accurate, and easy-to-use method of changing map scale. It is essentially a vertical camera which is used in much the same manner as a tracing table. The image of the source map is projected through a lens onto the underside of the compilation map so that the desired features can be traced directly onto the drawing. Many of the scale-change problems in map compilation are instantly solved by the use of this instrument. In addition, finished drawings can be reduced to reproduction scale so that size of type, line weights, etc., can be checked.

The Carto-Compiler projects the image of the source map (A, Figure 1) upward to the underside of the compilation map (B, Figure 1) which is supported by a piece of plate glass in the opening of the tracing board. By changing the positions of the lens board and the copy board in relation to the tracing board various degrees of enlargement or reduction are possible (Figure 1). With the use of a 162mm. enlarging lens, scale changes of sixfold magnification and reduction are possible. Use of lenses with a shorter focal length would make greater scale changes possible.

Movement of the lens board and copy board is achieved by a system of continuous chains on sprockets activated by a worm and worm gear linkage to the control handles (Figures 1 and 2). Use of the worm and worm gear allows for rapid smooth movement of these boards in either direction (up or down). When the proper adjustments are achieved the gear linkage holds the boards in place until the handles are moved again.

The source map is lighted by either two or four 500-watt bulbs which are located on the underside of the lens-board assembly. The arrangement gives a maximum amount of light on the copy when the lens board is at its lowest point. This is especially important because it is in this position that the most intense light is needed for maximum enlargement. Usually two lamps provide enough light for reduction, but for enlargement or when heavy paper is used for the compilation map four lamps are necessary.

The Carto-Compiler brings several important advantages to the small mapping operation. (1) A high degree of accuracy. Maimum distortion at 6× enlargement is less than 1/50 of an inch over the whole 18- by 24-inch tracing surface. (2) A great saving in time over nonphotographic methods of changing map scale. This time advantage is also important for mapmakers who do not have photographic facilities readily available. (3) Map-scale changes can be made with ease since adjustments are made by visually comparing the image

of the source map with the compilation map. No mathematical computations are necessary. Other advantages are the horizontal position of the tracing board, the large working surface available, better lighting, and smooth adjustments of the lens and copy boards.

There are certain disadvantages which must be considered in evaluating the instrument. (1) Large size—4½ by 7 feet floor area. (2) Height—the tracing board is 62 inches above the floor, necessitating a working platform 24 inches above the floor (Figure 1). (3) Need for semidarkness at the tracing board. (4) Compilation copy must be transparent or translucent. This is less of a disadvantage than might be supposed because tracings can be made through 2-ply Bristol Board, medium weight map paper, and all qualities of tracing paper.

The Carto-Compiler can easily be constructed by any do-it-yourself fan. Most of the parts are standard catalogue items which are ready to use as received (See list below). Three parts had to be specially made: the tracing platform, which is made of plywood; the lights, which any tinsmith can easily make; and the two handles. Most homeowners have the necessary tools (electric drill, wrenches, pliers, hacksaw, and screw drivers) for construction.

LIST OF PARTS AND APPROXIMATE COST*

Sprockets—24	$91.00
Pillow blocks—20	26.00
Steel worms—2	7.00
Worm gears—2	11.00
Collars—6	3.00
Steel ladder chain—100 feet	27.00
Steel channel posts, 5 ft.—4	24.00
Channel, 10 ft.—4	19.00
Assorted clamps, nuts, and bolts for steel	22.00
Cloth for bellows—5 yards	5.00
Tracing board and work platform	69.00
Shop work, for handles, lamps, etc.	52.00
Lens, 162mm.—1	75.00
Wiring	30.00
Bolts, screws, and paint	15.00
	$476.00

* Costs may vary depending on how much custom work is hired.

Fifty Years of Aviation Cartography

In September 1959 West Germany's Bundesanstalt für Flugsicherung, in cooperation with the Deutsche Gesellschaft für Kartographie (German Cartographical Society) and the Deutsche Gesellschaft für Photogrammetrie (German Photogrammetric Society) will present an exhibit entitled *Fifty Years of Aviation Cartography*. The exhibit, which will be displayed in the Inner Court of the College of Science and Technology, in Munich, will illustrate the historical development of aeronautical charts and show examples of representative modern chart series.

United States producers of aeronautical charts have been invited to submit items, historical and modern, for possible inclusion in the exhibit.

The exhibit recognizes the fiftieth anniversary of the publication of the first aeronautical chart, in Germany in 1909.

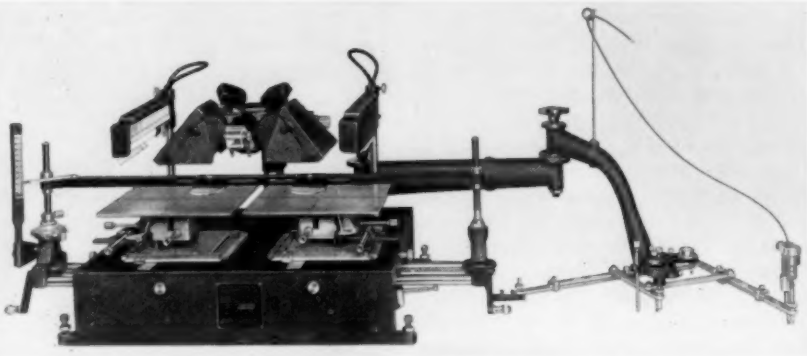
Also planned in conjunction with the anniversary celebration is a bibliography of recent references relating to the construction and use of aeronautical charts. This publication will supplement and bring up to date the following reference lists, published several years ago:

Meine, Karl-Heinz. Flugsicherung und Luftfahrtkarte. Nachrichtung aus dem Karten- und Vermessungswesen (Frankfurt, Germany), v. 1, no. 1, 1956: 31–65. Lists 105 references.

Meine, Karl-Heinz, and E. Reents. Die Neuzeitlichen Luftfahrtkarten und ihre Anwendungsbereiche. Frankfurt, Germany, R. Eisenschmidt, 1957. Includes a bibliography with 92 references.

Ristow, Walter W. Aviation Cartography, a Historico-Bibliographic Study of Aeronautical Charts. Washington, D. C., Library of Congress, Map Division, 1956. Includes a bibliography with 460 references.

—WALTER W. RISTOW
Library of Congress



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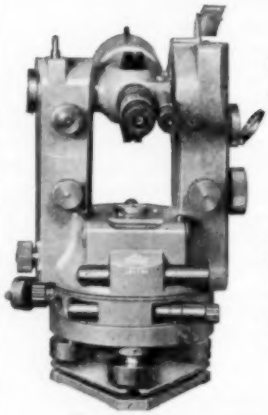

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LAND AND MINE SURVEYING INSTRUMENTS • FOUNDED IN 1762

The Land Surveyor and the Land Title Insurors

By HUGH A. BINYON

WEST COAST TITLE CO., ST. PETERSBURG, FLA.

IN PREPARATION for this Conference on Surveying and Mapping, and with reference to metropolitan planning, John Goggin asked me to discuss "responsibilities, prerogatives, and suggested cooperation between land surveyors and title insurance companies."

The "prerogatives" are limited and can readily and simply be disposed of by saying that the title insurance company has the prerogative of declining to accept a survey for title insurance purposes. A survey, when incorporated within a policy of title insurance becomes a responsibility or liability for the title insurance company, to defend at its own expense. Too few land surveyors are voluntarily financially responsive in cases of losses due to faulty survey—and it is almost as difficult to sue a land surveyor as it is to sue an attorney. So much for the "prerogative" section.

The individual topics "responsibilities" and "suggested cooperation between land surveyors and title insurance companies" are not subject to such simple disposition. The reason for this is that most laymen, and many land surveyors outside of metropolitan areas (and too many within metropolitan areas) do not understand the "why" and "what for" of title insurance.

As I go along from here you will occasionally wonder "what has this to do with land surveying or title insurance?" A painted picture is a series of paint dabs—and possibly overlays of some paint dabs on others. I am going to attempt to paint a word or idea picture, and I hope that when I have finished with my "dabs" here and there I will have presented the picture of the land surveyor and the title insurance company. It is very necessary to have the picture show both of them within one frame.

To paint the picture it is necessary to use dabs of mathematics; previous and existing laws; human nature; customs—both past and present; and court decisions. The fact that all of these except the mathematics are constantly changing also plays an extremely important part.

To furnish a background for this picture, I wish to quote from a paper given by George E. Harbert, a nationally accepted title authority, to a large group of lawyers who attended a short course for title examiners at the University of Illinois. The quotation is the shortest cut to the contained information that I have been able to find:

> Mathematical certainty of a good title is impossible. The simplest title, such as a patent from the State, requires a legal opinion on at least three facts: (1) the proper execution of the patent in accordance with the *then existing law;* (2) a correct description of the land involved; and (3) assurance that a prior patent (of the same land) has not been granted.

Please note that the description used in the original government patent (or deed) is subject to question. Also, please note that these men were dealing only with *title to the land.* They did not bother to determine that the land actually existed!

Mr. Harbert then quotes another authority. It is a lengthy quotation, but it so thoroughly covers the effect of changing times, court attitudes, and similar matters, with their subsequent effect on land surveying and descriptions, in much fewer words than I would need minutes to express the ideas:

> In a farming district the ownership of realty is popularly known; family history is familiar

Presented at the Florida Surveying and Mapping Conference, University of Florida, Gainesville, March 15, 1958.

to the neighborhood; boundaries are recognized by rough but sufficient measurement; and each owner is in actual possession of his premises and uses substantially the whole of them. In such a community each member knows what a purchaser expects to get for his money and no one sympathizes with a speculative attack upon title or a technical refusal to complete a bargain. Consequently, the law of marketability makes a close approach to common sense and justice. In metropolitan areas, on the other hand, very different standards prevail. Real estate has marvelously increased in value and is bought not necessarily for possession and use, but frequently for speculation; family affairs may be unknown to even the closest neighbors; and, where every inch is valuable, precision of measurement becomes indispensable. * * * Consequently, the most minute technicality may become the foundation of attack upon title, while public opinion has little, if any, restraint upon claimant. * * * When, therefore, the law of marketability is modified by metropolitan cases, it grows technical and complex, and the judicial point of view wavers between protection of honest title against adventurous attack on the one hand, and on the other the discountenancing of slipshod conveyancing and dishonest litigation brought to cut off genuine rights without due notice. The more complex the subject grows, the more the claimant is encouraged to litigate and the more nearly perfect must a title be to be held marketable. Fortunately, the attitude of the courts has, in spite of this development, remained liberal, and has sanctioned highly technical rulings in only a few topics.

These quotations embody thoughts known to some, suspected by others, yet which remain entirely unknown and foreign to those who attempt to approach land surveying solely as a mathematical science.

I presented these quotations to show that the approach to the interpretation of many land survey descriptions of past decades must be made with an understanding of the attitudes of the people who wrote the descriptions, and to show that courts do recognize public opinion to a point that some decisions rendered thirty or more years ago might vary from the decisions that might reasonably be expected today.

This matter of changing laws—or the interpretations thereof—customs, and court decisions may explain why today's court decisions do not always follow decisions of past cases; or it may explain why some particular recent decision did not coincide with your idea of how it should have been decided, your ideas being based on that book which you have just read which bears a publishing date of thirty years ago!

Now let's get into abstracts and title insurance to see how real estate transaction methods are changing—and why such changes in transactions have brought land surveying more into the foreground where it is subject to much closer scrutiny and into much greater use than in the past.

In considering abstracts and title insurance, we should remember that although both are used in the evidencing of good title to land, neither one nor the other is an instrument for the actual transfer of title of land.

ABSTRACTS AND ABSTRACTORS

An abstract of title is merely a history of the title to a particular tract of land, and includes only the *recorded* items. This history or abstract of title is used solely to relieve the examining attorney of the unpleasant, and sometimes exhausting, clerical details in the searching of courthouse records.

An abstract of title should contain a summary of all grants, conveyances, wills, and all records of judicial proceedings whereby the title to a particular tract of land is in any way affected. The abstract should contain references to all encumbrances and liens of record, as well as all types of easements, showing whether they have been released or not, and should show and other such facts of *record* as may impair the title.

An abstract should be prepared by persons experienced and skilled in the business; the indices from which the abstract is prepared should be sufficient to enable the abstractor to prepare a complete abstract; and the abstract should be backed by financial responsibility to enable its maker to pay for any damage caused by an error in his product.

Generally speaking, only those items which have been made of record *in the office of the Clerk of the Circuit Court* (or

Recorder) in the county in which the subject land lies will appear in an abstract. Except on special request, most abstracting companies do not search for special assessments not recorded as mentioned above, and very few abstractors show such items as judgments in City Courts or Small Claims Courts, zoning ordinances, or ordinances dealing with sewers, drainage, rentals, etc.

Without exception, however, *all abstractors show descriptions exactly as they appear of record*—even though they know that by changing only one letter, or one figure, they can correct a description. (In cases involving typographical errors they generally underline an incorrect letter or figure.) The abstractor's job is to show what is *on the record*. Most abstractors omit many standard words and phrases when abstracting legal matters, but in so doing they assume the responsibility for any omission of any pertinent words or phrases which will change the meaning of the original instrument.

The first instrument generally shown on an abstract is a governmental grant or patent. In the case of a platted lot, the succeeding entries following the grant or patent will deal with descriptions of tracts of land which are either all or part of the land in the governmental grant which embraces the particular lot in question. Some lots may straddle the line between two or more governmental grants, making it necessary for the abstractor to show a chain of title running from each of the two grants up to the time of consolidation of the two tracts affecting the lot, and then continue a consolidated chain of title up through the plat.

The mere existence of an abstract for a tract of land does *not* guarantee good title to the land described in the caption of the abstract—even though the name of the company preparing the abstract is a name containing words which might lead one to believe that the title was guaranteed when one obtained an abstract from it. Some people erroneously refer to a title insurance policy as a "guaranteed abstract." An abstract may be a perfect abstract (or history), yet the title to the land described in its caption may be so encumbered and defective, as revealed by a competent examination of the abstract, that a prudent man would hesitate to accept the land as a gift.

It is not always—I should say it is seldom—competent practice for a surveyor to survey a tract of land described in the caption of an abstract based solely on the information contained in the abstract. The abstractor is not required to know if a section or a quarter-quarter section is oversized or undersized, *or if the land actually exists!* When an abstractor prepares an abstract for the north 1320 feet of the NW quarter of a section after he has prepared an abstract for the south half of the NW quarter, he does so with his tongue in his cheek, knowing that some day there will be controvery concerning either an encroachment or a hiatus located near the east-west centerline of the NW quarter. Depending on the custom in his county or State, he may or may not show the deed to the south half of the NW quarter which was previously recorded. If he does, he will mark such entry as "Information Only."

To be able to determine title lines, a surveyor needs information concerning adjoining properties. Such information is available from an abstractor's tract records, which are generally more complete and arranged in a more readily available and useable form than are the official records of the office of the Recorder. The Recorder files his records chronologically and indexes them alphabetically, whereas the abstractor files his records chronologically and geographically, with emphasis on the geographic phase. The abstractor may or may not make a charge to the surveyor for information given. If there is a charge for the abstractor's service, it will generally be small compared to the time that would be required for the surveyor to make a similar search. It should be remembered that the abstractor's job is to prepare complete histories of properties, and that his office either has all descriptions affecting all properties in his particular area, or has an index which will enable one to find such descriptions—*completely,* and with a mini-

mum of expended time and effort. He can be of great assistance to the surveyor.

TITLE INSURANCE

An abstract of title and a policy of title insurance are often mistakenly considered by the layman to be one and the same thing—with some slight difference which they generally cannot explain. This "slight difference" may be the difference between having good title and not having as much as a "color of title."

An abstract of title is only a history of transactions, *as recorded,* affecting the title. Very, very few laymen can read an abstract and determine if the title is sound and merchantable. Generally the layman employs an attorney to examine the abstract and advise him of the status of the title. The abstractor has already *guaranteed* that all items affecting title of the caption land are included in the abstract; the attorney will, after examination, render his *opinion* of title *as revealed by the abstract.* Neither the abstractor nor the attorney *guarantees* boundaries, quantity, or location of the land concerned, nor can either be responsible for forgeries, frauds, or acts of omission or commission *not of record.* In some States, including Florida, an attorney *can* offer a guaranteed opinion by using some form of title insurance *in addition* to his usual opinion of title. A title insurance company generally compiles records much in the same manner that an abstractor does, and examines its own files of records or has an abstractor prepare an abstract for the title insurance company's purpose. The title insurance company then has their search (or an abstract) examined by one of their own examiners; or employs an attorney acceptable to the title company to make the examination. If the title appears to be valid and merchantable, the company will issue an insurance policy guaranteeing the validity of the title as set forth in the policy. The title insurance policy, when issued, *does insure* against such items as forgeries, frauds, and many, many other items not of record. When rendering an opinion indicating that his client should not purchase a property based on an abstract of title, it is not unusual for an attorney to advise his client that a title insurance company might insure against the objectionable defects in the title. In such instance, if the client can obtain title insurance, the client would be protected against loss due to the defects. If the application for title insurance is accompanied by an *acceptable* survey of recent date, properly prepared by a registered land surveyor, the title insurance company *will* insure the land involved as to location, quantity, boundaries, encroachments, etc., usually at no additional premium. Since the title insurance company does not usually make an additional charge for insuring the survey, one should not assume that the surveys are unimportant or that they are uniformly dependable and correct. They are extremely important, and too often incomplete or incorrect. Each survey plat is very carefully examined before being accepted for use with a policy of title insurance.

This short discussion on abstracts and title insurance is not intended to represent a complete dissertation on the two subjects; it is merely to show the general differences between the two and to give an idea of *why* the title insurance companies want a surveyor to show what is on the ground *as it is, and also the record lines* in addition—not how they would be if prorated or if adverse possession, etc., were considered by the surveyor. The title insurance company's examiner must make his own decision as to ownership of questionable areas. Some land surveyors have had the idea that they should prepare two separate plats—one to show record lines, and one to show actual occupation. That is not correct. The "as is" and "record" should show on the one plat so that any encroachments or overlaps are readily discernable and cannot be questioned.

This discussion is not intended to indicate that an abstractor is only a clerk who assembles the records. In addition to being an exacting clerk, the abtractor must also be well acquainted with all land law, probate law, and many other fields of law, as well as court procedures. The title insurance man is basically an abstractor who, in some

cases, may be no better qualified to examine a title than are some abstractors, but he is one who is willing to take calculated risks in insuring his opinions against financial loss to his clients. All titles are not insurable as some have too many serious defects.

Abstract companies seldom have to pay claims inasmuch as they only search and compile records with a carefully worked out and time-proven system. The abstractors' liability is only for the correct and complete compilation of the records.

Title insurance companies do pay claims. During 1955 and the first six months of 1956, seventeen of the forty-one title insurance companies on the Atlantic Coast from Washington, D. C., to Jacksonville, Fla., paid out $392,000.00 in claims for loss or damage. A large percentage of these claims were the result of faulty surveys.

Possibly you wonder why title insurance has so "suddenly" come into such prominence during the last thirty years. Until about 1930 the funds for mortgage lending were generally obtained locally without any idea of assigning such mortgage paper to distant lending organizations. Any distant assignments were difficult because the buyer of the mortgage paper had to examine the bulky abstract in the home office (say New York) and quite often the New York attorney didn't know Florida laws. Too much confusion resulted, and the practice of using "approved" local attorneys was tried, and is still in use by some organizations.

With the advent of Home Owner's Loan Corporation, Reconstruction Finance Corporation, Federal Housing Administration, Veterans' Administration home loans, and the subsequent lending across State lines by many life insurance companies, a simple, financially sound method of guaranteeing either or both the mortgage and subsequent assignments, and the underlying title to these mortgages, which could be readily mailed with the mortgages and which would not require the tedious reexamination of abstracts, became desirable and necessary to facilitate and reduce the cost of the total transaction. In addition, these lending agencies wanted dependable survey information, which was not available with the use of abstracts. The local title insurance men were acquainted with both the local surveys and the local surveyors. Consequently, the title insurance companies now insure the quantity and location of the land as well as the title to the land for such transactions.

Title insurance was the answer to the problem because seldom more than four pages of paper comprising the title policy (five pages when a one-page survey was included) would need to accompany the mortgage paper to any place in the world. Such a title insurance policy insuring the mortgage has the backing of statutory reserve indemnity funds such as are required of life insurance companies. The mortgage being insured remained insured without further need of reexamination when passed from hand to hand. The title to land as well as a mortgage is insurable, thus making it possible to buy or sell real estate with the same facility.

Due to its effectiveness and simplicity, title insurance has come into such popular use in the metropolitan areas of Florida that in several communities the use of title insurance has replaced the use of abstracts in over 70 percent of the transactions. Much of this popularity is due to the fact that the title insurance company will insure the location and quantity—as well as quality, when easements are concerned—of the land in question, according to an acceptable survey which is attached to and made a part of the transaction and insurance policy.

When insuring the title to land in a real estate transaction, the title insurance company becomes a third party to the deal, according to a Florida Supreme Court decision of about five years ago. In becoming such a financially liable third party, the title insurance company has the right to determine whether or not a survey meets the requirements of the transaction.

In developing an accurate and difficult survey based on records and facts, cooperation between the land surveyor and the title insurance company is essential. The title insurance company needs the section breakdown to interpret a description; the land surveyor needs the various descriptions

of adjoining lands within a section to determine intentions of past grantors in order to prevent encroachments and/or hiatuses.

A few of the large-scale public developments wherein the land surveyor and the title insurance companies have been, and due to their continued liabilities, still are, in complete cooperation are as follows:

1. *Michigan Toll Road.*—The project linear survey was laid out on airphoto mosaics. Engineers drew the route and showed right-of-way land required on photo mosaics. Land surveyors transferred right-of-way lines from photo mosaics to land. Title insurance companies and land surveyors determined whose land was affected. Land surveyors surveyed the affected land. Both title insurance companies and land surveyors cooperated in writing descriptions of lands to be condemned or purchased. Title insurance companies insured title of land to Toll Road Authority.

2. *O'Hare Airport, Chicago.*—Seven thousand acres acquired through joint efforts of title insurance companies and land surveyors.

3. *Subdivisions in the Sky.*—Grand Central Terminal (New York), Chicago Union Station, Merchandise Mart (Chicago), Chicago Post Office, Sun-Times Newspaper (Chicago), and Prudential Insurance Co. Building (Chicago).

All of these last were built over railroads or over railroads and adjacent lands. In some cases, the owner of the building owned the land and leased the space under or in the building to the railroad. In other cases, the railroad owned the land and leased caisson, column, and "air rights" to the owner of the building. There are other variations of ownerships and leaseholds. Office leases therein are weirdly but effectively described in three dimensions, allowing easements for hallways, elevators, columns, caisson lots, etc. A veritable land surveyor's nightmare, but such do exist, with titles to the lands and leaseholds insured!

The title insurance company, or the abstract company, can be of assistance to the land surveyor in his preparation of plats. Pinellas County now requires evidence of ownership before a plat will be accepted to record. Errors in plat boundary descriptions have often been found and corrected under this system, before the plat was filed. On several occasions drainage and/or power line easements were found of record that had been missed by the land surveyor.

The land surveyor can be of assistance to the title insurance company, when making a resurvey, by indicating both the old basis of bearings and the new basis of bearings on the plat or map, or by noting in the new description that the new bearing and course describes a certain line in the old description as contained in the deed or mortgage as recorded in a certain deed or mortgage book. Also, when filing a new plat, the land surveyor is giving valuable information to the title company when he shows adjoining subdivisions.

In many cases where an abstract is not available and a title in a transfer is to be insured, one of the parties to the transaction will "jump the gun" and, without knowledge of the title insurance company, order a survey—without having the correct description. The end result is that the survey description and the title insurance description do not agree. This results in more and unnecessary work for the land surveyor, and usually a postponement of the closing of the deal.

The land surveyor can be of great assistance to title companies, abstractors, attorneys, county officials, and everyone in general in his selection and use of names for plats. Here is an example of one which seems unnecessarily extended: "Sunhaven Homes—Unit Two—'Revised' Replat of Lots 17 Thru 48, Block 12." That is the actual and correct title of that plat. When used for title purposes, it must appear exactly that way on all legal documents, without abbreviations or deletion of any words or punctuation. In city work, especially, the title insurance company is interested in the location of underground footings which may encroach on unrecorded sewers. This information can be supplied by the land surveyor.

Many times it has been said that the land surveyor of today must follow in the foot-

steps of the land surveyor who went before him. That hot breath he sometimes feels on his neck when so engaged could be from the title insurance company man who is trying to keep up with him and help him to do the job right.

There is still a lot of paint on the palette, but my time is running out. Possibly my "dabbing" has brought an outline of the whole picture to you. You must remember, however, that there is much left unsaid here, and that although the picture which is supposedly complete may appear to remain motionless, there is, and there always will be, an imperceptible forward movement.

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Cooperative Study of Surveyor Education in California

The California Council of Civil Engineers and Land Surveyors has appropriated $500 for a cooperative study with the American Congress on Surveying and Mapping whose Education Division, under the leadership of Chairman F. H. Moffitt, currently plans to canvass the State of California by questionnaire in prelude "to developing a national canvass to determine the professional and technical education factors concerned with professional surveying and mapping," which in turn ties in with the ACSM's current "Status" studies. The California Council's interest, reflected by Executive Director William A. White's July 22, 1959, letter to members, is "for a cooperative study with the ACSM on the demand for surveying technicians and education of same." ACSM President Bestor reports that Chairman Moffitt is under way with the project.

—WALTER S. DIX
Executive Secretary, ACSM

Journal of Research of the National Bureau of Standards

Beginning in July 1959, the *Journal of Research of the National Bureau of Standards* will be issued in four sections:

Section A, *Physics and Chemistry,* will be issued six times a year. $4.00 per year, plus 75 cents additional for foreign mailing.

Section B, *Mathematics and Mathematical Physics,* will be issued quarterly. $2.25 per year, plus 50 cents additional for foreign mailing.

Section C, *Engineering and Instrumentation,* will be issued quarterly. $2.25 per year, plus 50 cents additional for foreign mailing.

Section D, *Radio Propagation,* will be issued six times a year. $4.00 per year, plus 75 cents additional for foreign mailing.

Subscription orders may be sent to the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Remittances should be made payable to "Superintendent of Documents."

ACSM Roster Questionnaire

A committee of Division representatives, under the chairmanship of Membership Chairman Borden, is planning a Roster Questionnaire to canvass ACSM membership this year. Questions will be designed to obtain pertinent information of Divisional and general ACSM interest for the selection "tab" coding of the ACSM's master mailing-plate file and to advise us of your preferred Divisional participation interest, as well as some facts on education, registration, and membership in kindred societies, in the professional interest. In order to present intelligent facts to the universities and colleges it becomes necessary to know how many professionals and technicians require education for positions now, and to replace today's practising professionals. Since age brackets enter such analysis, questions on age will likely be asked. This questionnaire will probably be mailed to the Membership in November, if not before. All members are urged to answer the Roster Questionnaire. Prompt return will insure inclusion in the proposed coded mailing-plate system, and in the roster records.

Need for Improvement in Quality of Surveys—How to Accomplish

By FRED R. PLACE

PRESIDENT, OHIO TITLE CORPORATION, COLUMBUS, OHIO

THIS is a "paper" and not a speech, and its subject is, generally, "Owners' Title Insurance and Surveys"—notwithstanding anything it says in the program. If there's any time left after I give the paper, I'll then make the speech.

Having agreed to do this job, my first thought was: How can I get someone else to furnish the material? So I sent out 80 questionnaires. I received 75 replies, which is about 94 percent.

The people who received these constitute a fair cross-section of the country from East to West.

The questionnaire and a tabulation of the answers are given in the accompanying table. The gist of this tabulation boils down to this:

No one covers survey questions generally on owners' policy coverage excepting in one spot in the New England area, and this is without added charges, for obvious reasons.

In California the coverage is available if the customer wants it and is willing to pay for it This same well organized approach exists in a large city in Illinois.

Generally, on the Northeast Coast the situation seems to be a "Yeah, we'll give it to them if they insist, and for free." As we go south on the East Coast, we encounter more resistance to this coverage. In fact, in one spot in the so-called "Deep South" I got a firm, negative, "Over my dead body," reply to the whole idea of survey coverage. This answer was given, however, with the qualified admission that he had on some occasions furnished survey coverage, but only after taking the utmost precaution—and he did it without any additional charge. The threat of loss of the business was not a factor.

Regarding propositions 2 and 3, the vast majority require a drawing reflecting the results of a survey made by an engineer approved by the title company. Some require a drawing and a certificate answering specific questions and a few will accept the certificate of survey only.

The amazing picture is presented by those companies who will, on occasion, insure against survey questions, if an approved survey is presented and who, after spending the additional time required to analyze the survey and after assuming the additional risk, *make no charge for it.* Some few make a flat charge as a service fee. The majority of those who do charge base it on the amount of the risk. This seems to be a logical approach. In Texas, they are confronted by legal restrictions on such charges.

Nearly all of my informants say they would have recourse against the surveyor for negligence and, in those areas where surveyors are required to be bonded, this is a real source of salvage. In other areas, the answer to this is, "his jeep and engineering instruments are exempt from execution, and what else does he have?"

These are extremes, however, and in the middle ground there are cases where surveyors have contributed a large amount of time and a little money to correct their errors.

You will note a substantial number are sure their competitor is giving away the stuff and not charging for it, but my questionnaire shows that sometimes this isn't true.

Lastly, note that 52 thought survey coverage should be given; 18 thought not; and

Reprinted from *Title News*, Vol. XXXVIII, No. 1, January 1959.

QUESTIONNAIRE

Re: Survey Coverage by Owner's (or Fee) Title Insurance Policies
(This does not apply to mortgage policies)

Questions	*Replies*		
	Yes	*No*	*No Comment*
1. Does your company usually insure against matters a survey might disclose?	30	45	0
2. If answer is yes, do you require a survey by:			
(1) Any registered surveyor?	16	0	31
(2) A registered surveyor approved by you?	28	0	0
3. If a survey is required, do you require:			
(1) A drawing showing all physical facts?	67	0	8
(2) Will a certificate by the surveyor, supplying answers to your questions suffice?	10	32	33
4. If survey coverage is included in your policy, is an additional charge made?	27	36	12
5. If an additional charge is made, is it based on:			
(1) The amount of coverage?	21	0	34
(2) Flat charge?	2	0	0
(3) What someone in the office thinks the risk is worth?	0	0	0
6. In your State would you have legal recourse on your surveyor if you suffered a loss because of his error?	62	2	11
7. Would the error need to be sufficiently gross to constitute malpractice? (Several of 11 explained proof required.)	40	11	24
8. If you do not furnish coverage against survey questions as a general rule, do you on special cases?	50	4	23
9. If so, do you charge for it?	25	22	28
10. Does your local competitor furnish this coverage?	58	11	0
11. If he does, does he charge for it?	22	36	17
12. Do you think you should furnish this coverage?	52	18	5

5 were noncommittal. Of the 52, there were some who were not furnishing survey coverage now. Of the 18 negatives, some were now furnishing it. Of these 18, several cited the difficulty in getting proper engineering data on which to insure. Three who were now furnishing the coverage and charging for it answered "no" to the question of whether or not the coverage should be furnished.

The sad part of this picture is that the average title policy buyer does not fully comprehend that he is not protected. In the first place, he does not comprehend title. A case in pont is that of the owner of a motel in Santa Barbara, Calif., who went there from the State of Washington, closed the deal, and then discovered his neighbor's fence inclosed seven feet of his rear yard. He went to the title company

and was told his title policy did not cover this situation. His question—"What good was the title policy, anyway?"

In addition to the eight bucks I paid him for his cab, I also gave him fifty dollars worth of free legal advice. I hope be acted on it. The fence was erected by permission of the former owner of the motel so the neighbor could build his house within two feet of his property line, contrary to the Santa Barbara building code. The fence was to fool the building inspector—and it did—but it's still there and the neighbor doesn't want to take it down.

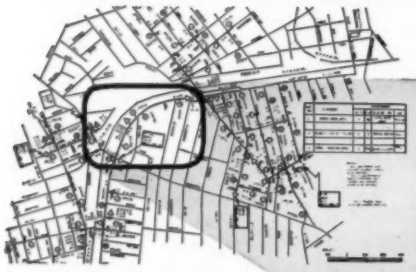
In conclusion, may I state that it is my prediction that some day we will all be insuring the facts of possession and those an accurate survey would reflect. I also realize that before we reach that point we will make more turns than I did in driving from Lompoc, Calif., to San Francisco on State Route 1.

Credit Where Credit is Due

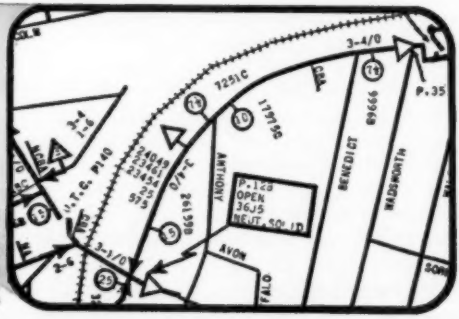
Since January 1951 the Department called *Map Information* has appeared in SURVEYING AND MAPPING. This Department began with a list of Geological Survey maps but has been expanded to include Lake Survey Charts, Public Land Survey Plats, Coast and Geodetic Survey Charts of special interest, and a new list in this issue, General County Highway Maps.

For the past 8½ years the Geological Survey lists, and later the Lake Survey Chart lists, have been compiled for publication by Sophia E. Thompson, now a Publications Editor in the Survey's Technical Information office. Her new duties make it necessary that she be relieved of this work and A. C. Kalbfleisch and his staff, in the USGS Map Information Office, will take over beginning with the next issue. Mrs. Thompson's long and faithful service to ACSM and SURVEYING AND MAPPING is appreciated.

CHART-PAK precision-slit tapes and symbols laid out these streets, water mains and switches in 8 minutes 45 seconds.



HOW LONG WOULD IT TAKE YOU TO DRAW THEM?



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Surveying and Mapping Literature

Members are requested to send in surveying and mapping news items for publication in SURVEYING AND MAPPING.—EDITOR.

MAGAZINE ARTICLES

General Interest

THE INTERNATIONAL GEOPHYSICAL YEAR AND SURVEY OF INDIA'S CONTRIBUTION TOWARD IT. Lieut. Colonel S. K. S. Mudaliar. *The Journal of the Institution of Surveyors* (India). Vol. 5, No. 2, August 1958. (Describes activities in latitude and longitude observations, geomagnetism, oceanography, gravity surveys, and glaciology.)

BASIC SURVEYS FOR BEACH AND HARBOR STUDIES. Rear Admiral H. Arnold Karo, Director, Coast and Geodetic Survey. *International Hydrographic Review,* Vol. 35, No. 2, November 1958. (Describes investigations to obtain basic data on causes of beach erosion, shoaling, and other problems of coastal engineering.)

THE SURVEYOR IN ANTARCTICA. J. H. Miller. *New Zealand Surveyor,* Vol. 22, No. 5, February 1959. (Notes on the participation and accomplishments of New Zealand surveyors and scientists in the IGY program for Antarctica.)

THE PLANNING OF ENVIRONMENT. Robert T. Kennedy. *New Zealand Surveyor,* Vol. 22, No. 5, February 1959. (Discussion of the functions and purposes of town planning.)

MOON BOUND. Raymond J. Seeger. *Journal of the Washington Academy of Sciences,* Vol. 49, No. 2, February 1959. (General discussion of man's age-old aspirations to reach the moon.)

THE COLUMBIA BASIN PROJECT. (No author given.) *The Reclamation Era,* Vol. 45, No. 1, February 1959. (Review of the phenomenal economic and social development of Central Washington State since the construction of Grand Coulee and other dams to provide irrigation for the area and hydroelectric power for the entire Pacific Northwest.)

HOW WE ACQUIRED OUR LANDED ESTATE. Karl S. Landstrom. *Our Public Lands,* Vol. 8, No. 4, April 1959. (Part II of an article already reported.)

WHAT PRICE SOCIALIZATION OF ENGINEERING? Donald A. Walsh. *Civil Engineering,* Vol. 29, No. 4, April 1959. (Deplores growth of performance of engineering services by government agencies.)

GREAT OPPORTUNITIES IN CIVIL ENGINEERING RESEARCH. Lee A. DuBridge. *Civil Engineering,* Vol. 29, No. 4, April 1959. (Discussion of engineering problems and need for research and prompt attack on problems of the future.)

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THE NAVY AND RADIO ASTRONOMY. Rear Admiral Rawson Bennett, Chief of Naval Research. *Naval Research Reviews,* April 1959. (Description of uses and potentialities of radio astronomic operations.)

NINETY FEET TO THE STARS. (No author given.) *Naval Research Reviews,* April 1959. (Describes concept, construction, and installation of two 90-foot radio telescopes in Owens Valley, California.)

CLARITY: AN ESSENTIAL IN THE ENGINEER'S REPORT. Prof. W. P. Albrecht. *The American Engineer,* Vol. 29, No. 4, April 1959. (Suggestions for clarity in presenting results of important investigations.)

NEW ERA OF THE GREAT LAKES. Nathaniel T. Kenney. *The National Geographic Magazine,* Vol. 115, No. 4, April 1959. (Description of the St. Lawrence Seaway with interesting sidelights on construction problems and how they were solved.)

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ACROSS NICARAGUA WITH TRANSIT AND MACHETE. Robert E. Peary. *U. S. Navy Civil Engineer Corps Bulletin,* Vol. 13, No. 5, May 1959. (Reprint, by permission, of an article by the late Admiral Peary, which appeared in Volume 1, No. 4, 1889, of *The National Geographic Magazine,* in connection with the observance of the 50th anniversary of the discovery of the North Pole.)

LAKE SURVEY AND THE GREAT LAKES. Major Ira A. Hunt, Jr. *The Military Engineer,* Vol. 51, No. 341, May–June 1959. (A detailed description of the organization and function of the U. S. Lake Survey.)

DEMOLITION OF RIPPLE ROCK. F. D. Bickel. *The Military Engineer,* Vol. 51, No. 341, May–June 1959. (Description of blasting operation to remove the most notorious hazard to navigation of the inside passage to Alaska.

THE EARTH'S MANTLE. Gordon G. Lill and Arthur E. Maxwell. *Science,* Vol. 129, No. 3360, 22 May 1959. (Discussion of the proposed undersea drilling to ascertain the nature of the earth's mantle.)

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MAPS AND METRIC SYSTEM. Brigadier Gambhir Singh, Surveyor General of India. *The Journal of the Institution of Surveyors* (India), Vol. 5, No. 2, August 1958. (Describes program for conversion of mapping in India from the mile-foot-inch scale representation to the metric system and relates the immense difficulties involved.)

ARE YOU USING PAPER TERMS CORRECTLY? Thomas N. Cooke. *Modern Lithography,* Vol. 27, No. 4, April 1959. (Definitions of terms used. First in a series of articles.)

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MOBILE PHOTOMAPPING TRAIN. Lt. Col. S. Presser. *The Military Engineer,* Vol. 51, No. 341, May–June 1959. (Describes functions of the various units in the photomapping train.)

A PRACTICAL EQUAL-AREA GRID. Emanuel M. Ballenzweig. *Journal of Geophysical Research,* Vol. 64, No. 6, June 1959. (Discusses deficiencies of various methods used to date for mapping the geographical distribution of geophysical quantities and illustrates a method for constructing a parctical equal-area grid for use in such work.)

PAPER RESEARCH. (No author named.) *Technical News Bulletin, National Bureau of Standards,* Vol. 43, No. 6, June 1959. (Review of accomplishments during fifty years of paper research including development of high quality map papers; extensive bibliography.)

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GEODETIC CONTROL FOR PROJECTS. R. S. Chugh. *The Journal of the Institution of Surveyors* (India), Vol. 5, No. 2, August 1958. (Illustrated description of methods employed in connection with large construction projects.)

BOUNDARY SURVEYS. Lieut. Colonel S. K. S. Mudaliar. *The Journal of the Institution of Surveyors* (India), Vol. 5, No. 2, August 1958. (Description of methods used in India.)

STEREOTRIANGULATION WITH PHOTOGRAPHS FROM 10,000 m ALTITUDE. P. O. Fagerholm and A. Thunberg. *International Hydrographic Review,* Vol. 35, No. 2, November 1958. (Discussion of method with tables of results.)

A NOMOGRAM FOR THE DETERMINATION OF SOLAR ALTITUDE AND AZIMUTH. C. L. Mateer and W. L. Godson, Meteorological Service of Canada. *Monthly Weather Review,* Vol. 87, No. 1, January 1959. (Describes combination nomogram for calculation of solar altitude and azimuth for any latitude, solar declination, and time of day.)

A CIRCUM ALMUCANTAR OBSERVATION FOR AZIMUTH. G. J. Thornton-Smith. *Empire Survey Review,* Vol. 15, No. 112, April 1959. (Mathematical discussion with theory of reduction formula and examples.)

THE LEAST SQUARES ADJUSTMENT OF GEODETIC TRAVERSE. B. T. Murphy. *Empire Survey Review,* Vol. 15, No. 112, April 1959. (Discussion of method with theory of three condition equations applied to a typical example.)

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AN ACCOUNT OF THE SURVEY CARRIED OUT BY THE FALKLAND ISLANDS DEPENDENCIES AERIAL SURVEY EXPEDITION, 1955–56, 1956–57. A. D. Bancroft. *Empire Survey Review,* Vol. 15, No.

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The Neglected Capital. Sydney Steele. *Journal of the Franklin Institute*, Vol. 267, No. 4, April 1959. (Criticism of our failure to cultivate adequately our most important capital—Brainpower.)

Journey Toward a Successful Life. Francis S. Friel *Civil Engineering*, Vol. 29, No. 4, April 1959. (Portion of an address to alumni and students of Manhattan College, March 15, 1959.)

Science and Education in the Washington Area. Frank L. Campbell. *Journal of the Washington Academy of Sciences*, Vol. 49, No. 4, April 1959. (Describes volunteer work of lecturers in science and technology sponsored by the Joint Board on Science Education of the Washington Academy of Sciences and the D. C. Council of Engineering and Architectural Societies.)

The Needs in Engineering Education. Norman N. Barish. *The American Engineer*, Vol. 29, No. 4, April 1959. (Proposes graduate engineering school to alleviate shortages of professional talent in various specialized fields.)

Society, Science, and Education in the Soviet Union. Chauncy D. Harris. *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 45, No. 5, May 1959. (Author concludes, on basis of personal observation, that the Soviet Union has succeeded in training and utilizing a very large number of scientists and has been able to achieve high levels of scientific achievement in many fields including Geography.)

Professional Engineer Preparatory Course. Col. J. D. Strong and Lt. Col. Robert B. George. *The Military Engineer*, Vol. 51, No. 341, May–June 1959. (Describes 60-hour resident program of instruction developed by the Army Engineer School to enable qualified personnel to prepare for examinations leading to registration as professional engineers.)

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Some Modern Methods of Measurement of Distances. J. Chatterjee. *The Journal of the Institution of Surveyors* (India), Vol. 5, No. 2, August 1958. (Description of the Geodimeter is the first in a series of articles.)

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Contour Mapping Microdensitometer. P. Hariharan and M. S. Bhalla. *Journal of Scientific Instruments*, Vol. 36, No. 4, April 1959. (Description of apparatus.)

Property Surveys

Code of Practice for Building and Quantity Surveyors. P. S. Pandit. *The Journal of the Institution of Surveyors* (India), Vol. 5, No. 2, August 1958. (Treats mainly of the work of a drafting surveyor in the preparation of tender documents prior to contract letting.)

Some Engineering Aspects of Land Subdivision. C. H. Beach. *New Zealand Surveyor*, Vol. 22, No. 5, February 1959. (Summary of general observations on all aspects of the question.)

Historic Background of Land Surveying in New Zealand. Taken from 1958 report of Lands and Survey Department. *New Zealand Surveyor*, Vol. 22, No. 5, February 1959. (Review of activity since 1840.)

The Decimal Foot. A. J. Lines. *The Australian Surveyor*, Vol. 17, No. 5, March 1959. (Discussion of a resolution calling for adoption of the foot with subdivisions by decimals instead of the foot, inches, and fractions.)

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PLANE COORDINATE INTERSECTION TABLES (2½ MINUTE)—COLORADO. Coast and Geodetic Survey, Publication 65-1, Part 5. Available from Superintendent of Documents, Government Printing Office, Washington 25, D. C. $1.00.

RADIO TELEMETRY APPLIED TO SURVEY PROBLEMS. Richard R. Ross. U. S. Department of Commerce, Coast and Geodetic Survey, Technical Bulletin No. 4, February 1959. Available from Superintendent of Documents, Government Printing Office, Washington 25, D. C. $0.15.

—LYMAN D. LYNN
Coast and Geodetic Survey

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Modern Maps in a Changing World

The New York Public Library supplied a variety of views of the earth and its inhabitants by means of an exhibition—"Modern Maps in a Changing World"—of some 50 selected maps displayed from June 30 to September 30, 1959, in the third floor (south) gallery of its building at Fifth Avenue and 42nd Street in New York City. The maps were chosen by Gerard L. Alexander, Chief of the Library's Map Division, with a view to pointing out the latest mapmaking techniques now being employed all over the world.

The New York Public Library has a collection of over 200,000 maps and more than 5,000 atlases, representing every period of mapmaking from the 16th century to the present.

Distinctive Recent Maps

The *International Atom* maps world distribution of atomic energy agencies; power reactors, operating and in construction; radioisotope laboratories; suppliers of radioisotopes; and sources for uranium and thorium ore. Marginal data include a list of "Members of the International Atomic Energy Agency as of January 1959," and a brief summary of the development and use of atomic energy. The map measures 16½ by 44 inches. Copies, at three dollars each, may be ordered from the Public Relations Office, Stanford Research Institute, Menlo Park, California.

SAS Route Map Polar System charts the air routes followed by Scandinavian Airlines System on its regularly scheduled flights across the north polar regions. The map, which is centered on the North Pole and extends southward to approximately 30 degrees north latitude, is at the scale of 1:20,000,000. The folder, of which the map forms a part, includes an explanation of the navigational problems in flying over the Pole, and a summary description of the exploration and development of these northern lands.

A distinctive contribution to the glacial geology of this country is the new (1959) *Glacial Map of the United States East of the Rocky Mountains.* It is at the scale of 1:1,750,000 and is printed on two sheets each of which measures 35 by 41 inches. The map was published by The Geological Society of America, 419 West 117th Street, New York City. It was compiled and edited by a committee of the Division of Earth Sciences, National Research Council, consisting of Richard F. Flint, *Chairman,* Yale University; Roger B. Colton, U. S. Geological Survey; Richard P. Goldthwait, Ohio State University; and H. B. Willman, Illinois State Geological Survey. Ten different types of glacial deposits are mapped and the limits of the various ice advances are traced. Marginal data include a series of footnotes and "sources of data" both of which are arranged by States.

The progress of the Federal highway aid program is shown, as of February 1, 1959, on the American Automobile Association's *Map of the Interstate Turnpikes and Multilane Highways.* It is at the approximate scale of one inch to 75 miles and measures 25½ by 39½ inches.

Week-end skippers will soon be able to guide their craft with greater safety and assurance thanks to a new series of *Small-Craft Charts* introduced by the U. S. Coast and Geodetic Survey. The series will eventually cover the extensive system of harbors, inland and coastal rivers, intra-coastal waterways, and tidal estuaries of the United States. The only charts completed to date are for the Potomac River area, which region was selected for the pilot series. The Potomac charts have been prepared in four experimental formats which are now being tested by users. The format which proves most acceptable to recreational boatmen will be adopted for the series.

The approaching centennial of the Civil War will no doubt stimulate many publications, original as well as facsimile. The *Map of the Battlefield of Gettysburg, July 1, 2 and 3, 1863* is an interesting forerunner of the anticipated flood of such publications. It is reproduced from General G. K. Warren's map which is part of the *Atlas to Accompany the Official Records of the Union and Confederate Armies 1861–1865.* The facsimile is reproduced on plastic in three-dimensional relief by Aero Service Corporation of Philadelphia. It measures 21 by 14 inches and is available from Haverford Map Company, P. O. Box 58, Haverford, Pennsylvania.

The *Shenandoah National Park, Virginia* and its scenic Skyline Drive are realistically portrayed on an attractive three-dimensional plastic relief map also prepared by Aero Service Corporation, Philadelphia. Compiled from information supplied by the Army Map Service and the U. S. Geological Survey, the map shows in detail (1:250,000) the geographical and historical detail of this beautiful and popular recreation area. The map, which measures 15 by 19 inches, is printed in four colors. Copies, at $4.95 each may be ordered from Aeronautical Services, Inc., Annapolis, Md.

Canadian Iron Ore and the North American Iron and Steel Industry is the title of a 1958 map published by the Geological Survey of Canada (Department of Mines and Technical Surveys). It shows iron ore areas, developed and under exploration; iron ore consuming areas; and coal producing areas in eastern Canada and the eastern half of the United States. The map measures 28½ by 27 inches and the scale is 1:10,000,000.

The U. S. Army May Service has recently published, in colorful shaded relief editions, two sheets of its series of Planning Maps at the scale of 1:6,336,000. *Eur-Africa North* (No. 118213) includes all of Europe, the Mediterranean Sea and adjacent parts of the Middle East and North Africa, Iceland, southern Greenland and the North Atlantic Ocean. *Eur-Africa South* is centered on the Mediterranean and extends north

to the latitude of southern Scotland, and south to the delta of the Niger River. Both maps measure 37 by 46 inches.

The Geology of Sweden is presented on two maps published in 1958 by the Ab Kartografiska Institutet, Esselte Ab Stockholm. Both are at the scale of 1:1,000,000 and printed on three sheets, each measuring 21 by 29 inches. *Karta Över Sveriges Jordarter* shows the Quaternary deposits of the country. Areas of bogs and swamps; clay, silt, and very fine sand; sand, coarse fine sand, and fluvial sediments; eskers and deltas; moraine clay; exposed bed rock; and mountains are delimited. The map was compiled by G. Lundqvist, and is based on data derived from studies of several Swedish geographers and geologists. The pre-Quaternary rocks are mapped by N. H. Magnussen on *Karta Över Sveriges Berggrund*. Some eighty different rocks are identified.

Development Scheme for the "Conurbation Holland" spotlights the city and town pattern of the Netherlands. Also shown are areas of arable land; lands reserved for market-gardening; recreational areas, existing and planned; and waterways, railroads, airports, military lands, and cultural monuments. The scale is 1:200,000 and the size 29½ by 27½ inches. The map was prepared to accompany the "Rapport van de Werk Commissie Westen des Lands 1957."

Luftstrassen und Funkeinrichtungen shows Airways and Radio Facilities for West Germany. It was published in July 1958 by Bundesanstalt für Flugsicherung, Obernplatz 14, Frankfurt am Main, Germany. The scale is 1:2,000,000 and the size is 20 by 26 inches. Airspace Restrictions and Supplementary Data concerning Radio Facilities are given in the margins.

Deutschland Bodennutzung presents the generalized land utilization of Germany. The map, at the scale of 1:250,000, is number 1-b in "Keysers Wandatlas" series, and is based on information in Keyser-Lautensach's *Atlas zur Erdkunde*. Areas with specified percentages of cropland, pasture, and forest, are indicated by colors and symbols. The map sheet measures 33 by 45 inches.

A *Map of the Spanish Railways* was published in 1958 in connection with the Seventeenth International Railway Congress which was held in Madrid. The publisher is Rivadeneyra of Madrid. The map measures 29 by 36½ inches. There are seven enlarged insets for the major cities and their environs.

Two new maps of Africa were recently issued by France's Direction de la Documentation, 14–16 Rue Lord-Byron, Paris 8, France. *Carte Economique de l'Afrique* shows resources, industries, and communication systems of the continent. Distribution of natural vegetation and agricultural products are shown on *Carte Agricole de L'Afrique*. An inset map shows distribution of livestock. Both maps are at the scale of 1:10,000,000 and measure 33 by 31 inches. They were printed by L'Institut Géographique National.

Vegetation Map of Africa South of the Tropic of Cancer "is the product of international collaboration at a personal level, within the framework of the 'Association pour l'Étude Taxonomique de la Flore d'Afrique Tropicale.' Publication was made possible by generous assistance from U.N.E.S.C.O. Numerous experts have contributed to the map in various ways, but the responsibility for the final version rests with the editorial committee, viz. A. Aubréville, P. Duvigneaud, A. C. Hoyle, R. W. J. Keay, F. A. Mendonça, and R. E. G. Pichi-Sermolli." A booklet containing explanatory notes in French and English, prepared by Mr. Keay, accompanies the map. It describes some 32 vegetation types which are outlined on the 1:10,000,000 scale map. (33 by 30 inches)

Two interesting maps of national parks have been published by the Uganda Lands and Surveys Department. Both are at the scale of 1:125,000. *Murchison Falls National Park* straddles the Victoria Nile and borders lake Albert and the Albert Nile. The Park embraces an area of 1504 square miles. The abundant wild life of the area is portrayed in a series of small illustrations superimposed on the face of the map. More than forty varieties, ranging from squirrels to elephants and giraffes, are pictured. The map measures 25½ by 35½ inches.

The fauna of *Queen Elizabeth National Park*, which covers 767 square miles, are shown on a map of that refuge. This park lies between Lake George and Lake Edward, on both sides of Kazinga Channel which joins the two. Topography is shown, on this map, by contour lines. The map sheet is 36 by 25½ inches.

Malaya 1958, a two-sheet (each 27 by 41 inches) political-relief map, is a publication of the Survey Department, Federation of Malaya. At the scale of 1:500,000, the map shows generalized relief by color gradients, delimits administrative districts, traces transportation routes, and locates a number of cultural centers and features. An inset map shows "Malaya and Adjacent Territories."

—WALTER W. RISTOW
Library of Congress

IT IS NOT TOO EARLY TO BEGIN PLANNING TO ATTEND THE 1960 MEETINGS

The Surveyor and the Law

More and More on Proportioning

The property surveyor frequently finds situations that are not discussed or explained by standard textbooks. It is these perplexing problems and their solutions that stimulate thinking and prevent our profession from reaching the doldrums. Even simple problems sometimes require careful consideration. Below are two familiar sectionalized land problems that, to my knowledge, still have the last word to be said on them. Both are lost corner proportioning problems.

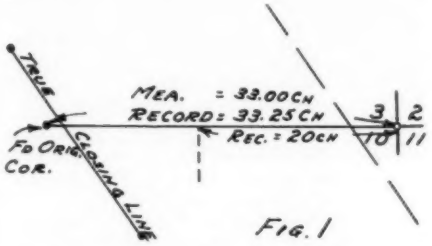


FIG. 1

In Figure 1, the closing corner and the section corner are both found. By rerunning the Rancho grant line it is found that the closing corner was set one chain within the Rancho grant. The original recorded distance to the closing corner was 33.25 chains, and the recent measure to the found original corner was 33 chains.

Problem: Where do you set the 1/16 corner which was originally shown as being 20 chains from the section corner? Two solutions exist, and these are:

(1) $20/33.25 \times 33 = 19.85$ chains.
(2) $20/33.25 \times 32 = 19.25$ chains.

The closing corner must, of course, be moved to the line closed upon (the Rancho line). The actual length of the line is then only 32 chains instead of 33.25 as originally recorded or 33.00 chains as recently measured. The 1/16 corner, never having been set originally, is always set by proportionate measurement between the corners to the east and west. But do you proportion from the grant line or from the original stone as set?

My contention has always been that since the original surveyor set a monument and recorded a certain distance to that particular monument, the recent surveyor should proportion from the found position of that original stone. After he has done this he relocates the closing corner on the true line closed on. In this illustration the fractional parcel to the west would receive the major portion of the shortage. The proportional measure would be

$$13.25/33.25 \times 33 = 13.15 \text{ chains.}$$

From this would be subtracted one chain, hence the western parcel suffers a loss of 1.10 chains, while the eastern parcel suffers only a

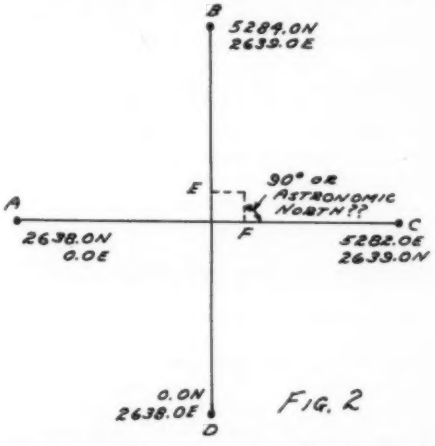


FIG. 2

loss of 0.15 chain. This is just. The fractional parcel was original given land that the government did not own, hence it must suffer that loss.

In one instance in California, closing corners were set more than 1,200 feet into a land grant (El Cajon). Obviously it would be impossible to prorate other than from the original corners. All of certain fractional parcels were found to be wholly within the Rancho. Since the government did not own the land, title could not pass. This would be equivalent to finding the true grant line in the position of the dashed line in Figure 1. If the true grant line were discovered

in this position, it is obivous that the 1/16 corner could not be prorated.

A second problem involves double proportioning. Suppose that the four quarter corners are found as shown in Figure 2 and that the record distances were each a half mile. The rule calls for a remeasurement from *A* to *C* and set a point halfway (*F*). Next, measure from *B* to *D* and set point *E* halfway. From point *E* a line is run east or west, and from point *F* a line is run north or south. What is meant by north and east? Do you run astronomic north and east, or do you run at 90° to the lines *AC* and *BD?* The problem of double proportioning is simplified if east and north mean due east and due north. The coordinates of the true corner would be

$$(5284.0\ \text{N} - 0.0\ \text{N})/2 = 2642.0\ \text{N, and}$$
$$(5282.0\ \text{E} - 0.0\ \text{E})/2 = 2641.0\ \text{E.}$$

Obviously considerable more calculation is required if east and north are interpreted to mean at 90° to the lines. Correspondence with the Bureau of Land Management indicates that they interpret the east and north to be astronomic and the method of computing coordinates as illustrated is correct.

Some of the record-of-survey checking departments (Los Angeles) insist that 90° to the lines is proper, others (San Diego) insist that astronomic east and north is correct. In most instances the differences will be negligible. However, occasionally when lines deviate substantially from north or east, significant differenees arise. I will take the Bureau of Land Management's letter as final (astronomic directions) until they indicate a change of thought.

I received the following letter from William C. Wattles, one of the surveyors in the Superior-Richfield case (*See* SURVEYING AND MAPPING, March 1959, Vol. XIX, No. 1, pages 101–103). Apparently there was adequate foundation for the possibility of using double proportioning; however, the court chose to use topography in preference to double proportioning. Unfortunately court reports only publish the winning side of a case, and such information as given by Mr. Wattles generally is not available.

—CURTIS M. BROWN

Dear Curt:

I read with interest your review and comments on the Chandler-Hibberd (Superior-Richfield) case Appellate decision. You did a good job of quoting and commenting. There is one item apparently which you overlooked or were unaware of.

The first three lines on page 102 of your article in SURVEYING AND MAPPING (March 1959) read—"the corners located more than a mile to the north of the disputed line fell within the limits of the Cuyama Rancho and were never set." This is incorrect.

The history of the Cuyama Rancho in brief is this. Shortly after the Commission for operation of the Treaty of Guadalupe was created, a petition for patent for the Cuyama was filed. After some time of consideration the petition was denied, and the land became Public Land. In 1854 surveyor Norris was authorized to survey the area and did so, covering T. 10 N., R. 26 & 27 W., and other land in the area. In so doing he surveyed and monumented in T. 10 N., R. 27 W., only sections between the south line of Sections 1 to 6 and north line of Sections 19 to 25, stating in his field notes that the latter line was run as a Township offset line. His field notes for both Townships give considerable topography.

In 1872 the petition for Patent of the Rancho was revived and granted. So, in 1872 surveyor Harris was ordered to survey the boundaries of the Rancho This he did, tying specifically by recital of lines and monuments found to section lines of Norris, as far as the south boundary of the ranch survey was concerned. The Rancho was patented and map recorded.

In 1881 & 1883, surveyor Glover was authorized to complete the survey of the T. 10 N., R. 27 W., and other land in the area. His field notes show he followed the south ranch line, finding the original corners set (or, rather, discovered) by Harris at the angle points of the Ranch boundary.

So we have a continuous location and positioning of the south Ranch line from original sectionizing, through patent, and boundary sectionizing.

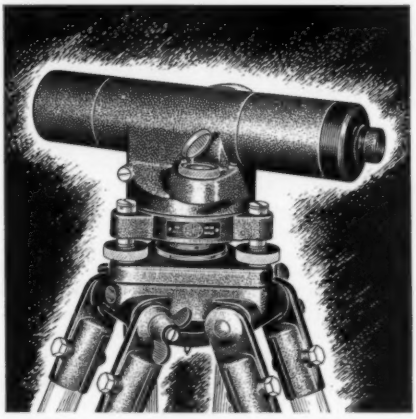
There is considerable information, some of it evidential, that the fence line purported to be the south Ranch boundary was set some 10 chains south of the patent boundary and partially monumented; due either to design to get more ranch area, or to faulty location of purported corners of sections of the Glover survey.

In Thomasson's and my run of the lines, we picked up some dozen original corners or bearing tree positions or reliable replacement monuments in Ranges 26 to 27; also some 20 excellent "topo" ties which gave corner positions of great strength. The record distances were exceptionally close to the remeasurement, and the bearings were also within limits. The total of our findings gave a clear indication that the

fence line purported to be the ranch line was incorrect. It was the only thing out of gear in the whole area, except a couple of bearing trees which were proven to be unassociated with proper section corners.

I thought this might clear you from any misconception as to location. Incidentally, the substance of the above notations was presented to the court as testimony, so there was judicial notice to warrant the decision in these respects as to the location of north line Section 36 (the disputed line).

Cordially,
WM. C. WATTLES



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Upheavals Along Shores of Alaska

Ships of the Coast and Geodetic Survey, U. S. Department of Commerce, left their winter anchorage at Seattle about April 15 to make deep-sea studies along the Alaska coast.

The Survey's oceanographers want to get answers to two questions, among others: How accurate are the reports that a section of the southeastern Alaska coast near Haines has risen nearly five feet since the Survey installed its tidal bench marks in 1890? And what did the violent earthquake of July 9, 1958, do to the bottoms of Yakutat and Lituya Bays?

Engineers working in the area have reported to the Coast and Geodetic Survey that the published elevations above sea level for the tidal benchmarks are now too low, the differences ranging from 4.7 feet at Haines to 2 feet at Juneau. Officers on the survey ship *Patton*, under Commander G. L. Short, will install new tide gages at twenty old stations and compare their recordings with the records of the permanent station at Juneau. They want to find out how much the ground has risen and over how large an area. The investigation should go far to explain the cause of the reported upheaval, which is apparently local. The shift is believed to be seismic in origin, as "mountain-building" is still going on along the Alaska coast, but it may be related to the release of pressure following the melting of glaciers.

Books in Review

WESTERN REGIONAL CONFERENCE—AMERICAN CONGRESS ON SURVEYING AND MAPPING. 8½ × 11, processed, illus., 74 pp.

This paper-covered book contains the papers and the discussions presented at the Western Regional Conference of the American Congress on Surveying and Mapping, held at Monterey, California, October 9–11, 1958.

The theme of the meeting was "Accuracy and Economy," and the various papers all deal in one way or another with methods and equipment available for use in the never-ending struggle to keep accuracy up and costs down.

The last few pages are devoted to a list of the nearly 400 persons registered in attendance at the conference and a list of the 17 exhibitors whose patronage made the conference possible. Information as to the availability of this publication may best be obtained from George C. Bestor, P. O. Box 3045, Carmel, Calif.

HOWARD S. RAPPLEYE

THE CALIFORNIA COUNCIL OF CIVIL ENGINEERS AND LAND SURVEYORS—SEVENTH ANNUAL CONVENTION. 8½ × 11, processed, illus., 72 pp.

This paper-covered book contains the proceedings of The Seventh Annual Convention of The California Council of Civil Engineers and Land Surveyors, held at Los Angeles, Calif., January 22–24, 1959.

Space does not permit a detailed statement of the contents, but such subjects as "Professional Fees," "Systems Engineering and Its Application to Long Range Planning," "Geology in Subdivision Development," "Electronic Computing Devices," "National Highway Program as It Affects California," "Mechanic's Lien Law as It Applies to Civil Engineers and Land Surveyors," and "Status of Surveying and Mapping" were covered.

Information as to the availability of this publication may be obtained from William A. White, Executive Secretary, California Council of Civil Engineers and Land Surveyors, 1107 9th St., Room 811, Sacramento, Calif.

HOWARD S. RAPPLEYE

3030 REVIEW QUESTIONS FOR SURVEYORS. Russell C. Brinker. 8½ × 11, processed, wire bound, illus., 296 pp. $4.64, including postage.

3030 Review Questions for Surveyors is the sixth edition of Brinker's book of questions. The first edition had but 1313 questions. Subsequent editions contained more and more questions each time the book was reprinted.

The present edition is divided into 26 sections, lettered from A to Z, inc., and covering the various phases of surveying and mapping "from A to Z" you might say. However, there are two more; AA—an appendix giving suggested abbreviations, a set of signals, and a list of references; and BB—which contains the answers to 2000 of the questions in the first 26 chapters.

The Z section, 42 pages, contains sample registration examinations; a total of 23 examinations from 16 different States, which should be useful to those preparing to take such examinations.

Despite the inclusion throughout the book of a goodly sprinkling of "true or false" and "multiple choice" questions, there is still a very large number of questions in which even the experienced practitioner could "sink his teeth" with both pleasure and profit.

This book is obtainable, at the price indicated above, from the author at 4217 Norfolk Lane, El Paso, Texas.

HOWARD S. RAPPLEYE

IT IS NOT TOO EARLY TO BEGIN PLANNING TO ATTEND THE 1960 MEETINGS

Abstracts of Articles on Geodesy and Related Fields

The Army Map Service, of the Corps of Engineers, U. S. Army, publishes quarterly a series of processed sheets under the title: "Abstracts of Articles on Geodesy and Related Fields." The following are excerpts from the issue bearing the date of April 1959 and are selected for reprinting in SURVEYING AND MAPPING as being of possible interest to a considerable percentage of our readers. The selection has been somewhat arbitrary, and only those abstracts believed to be of quite general interest have been included. —EDITOR

485 *Preparations for the Measurement of Absolute Gravity in Potsdam* (Vorbereitungen zur Messung der Absoluten Schwere in Potsdam). R. Schroeter

The article discusses some of the efforts being made to determine anew the gravity values obtained in 1906 by Kuehnen and Furtwaengler for Potsdam. It contains a detailed description of the new pendulum apparatus belonging to the Potsdam Geodetic Institute. The difficulties to be expected in future measurements with this instrument are discussed.

MITTEILUNGEN DES GEODAETISCHEN INSTITUTS POTSDAM (German) AMS-GL-B664.2350, No. 12 (1958)-ms

487 *Hydrostatic Crossings of the Elbe River in the Framework of the Leveling along the Coast of the North Sea* (Hydrostatische Elbuebergaenge im Rahmen des Nordseekuesten nivellements). H. U. Sandig and G. Scheel

The present paper reports on the execution and evaluation of the hydrostatic crossings of the Elbe River carried out in 1955 by the "Institut fuer Angewandte Geodaesie" at the request and with substantial support of the "Bundesanstalt fuer Gewaesserkunde," the LVA's Niedersachsen and Schleswig-Holstein and the Hamburg Survey Office. The old crossing at Scheelenkuhlen was very unfavorable for hydrostatic measurements due to the wide tidal flats on the south bank of the Elbe River, but it was to be measured as a second crossing at all cost because of its proximity to the coast. The measurements of the new crossing at Twielenfleth yielded reliable results without difficulties.

Near Blankenese, a loop could be measured by way of the Elbe River island Nessand, by measuring on the one hand from Nessand to both banks and, on the other hand directly from bank to bank in bypassing the island. The closure in this loop of 5 km. in length amounted to only 0.13 mm. Since three levelings were involved entirely independent from one another and measured on different days, this result can be considered as a guide line for the external accuracy of carefully established hydrostatic levelings.

DEUTSCHE GEODAETISCHE KOMMISSION BEI DER BAYERISCHEN AKADEMIE DER WISSENSCHAFTEN, Publications Series B: Applied Geodesy, No. 33 (German) AMS-GL-B664.2250, No. 33 (1958)-ms

488 *The Practical Work in Establishing Hydrostatic Leveling* (Zur praktischen Durchfuehrung von hydrostatischen Nivellements). H. U. Sanding and G. Scheel

The present paper describes the hose line and equipment for hydrostatic leveling developed by the "Institut fuer Angewandte Geodaesie." Suggestions are made for establishing hydrostatic leveling. Especially detailed is the discussion of the important and difficult procedure of filling the hose for which a method is given which permits filling it free from air bubbles with nearly complete reliability. This chapter also contains essential technical details on the filling equipment. Other suggestions and instructions deal with reconnaissance and observation as well as with laying and removing the hose. The final chapter gives a list of requirements in equipment, personnel, and time for a river crossing.

DEUTSCHE GEODAETISCHE KOMMISSION BEI DER BAYERISCHEN AKADEMIE DER WISSENSCHAFTEN, Publications Series B: Applied Geodesy, No. 32 (German) AMS-GL-B664.2250, No. 36 (1957)-ms

489 *Manufacture of Invar Wire and Invar*

Tape Base Line Measuring Instruments (Herstellung von Invardraht- und Invarband-Basisapparaten). O. Douglas

The mass production of invar wire and invar tape base line measuring instruments was started only at the beginning of the present century. The internationally used designation of "invar" for all steel with a coefficient of expansion of 1.0×10^{-6} or less is the basis for this study irrespective of the material used in the manufacture of the wires and tapes (invar, indalatans, superinvar, stainless invar, etc.). The presently used invar instruments are discussed and the different possibilities of construction of the essential individual parts are explained. The article is concluded by giving the point of view of the manufacturers with regard to modernizing their instruments and a proposal to arrange all such work within the framework of the International Geodetic Association of the IUGG.

ZEITSCHRIFT FUER VERMESSUNGSWESEN (German) AMS-GL-B664.7001, Vol. 83 (1958)-ms

490 *Studies for the Practical Computation of Anomalies of Refraction for the Purposes of Orientation According to Sun Altitudes* (Untersuchungen zur praktischen Berechnung von Refraktionsanomalien fuer die Zwecke der Orientierung nach Sonnenhoehen). H. G. Loeser

The normal refractions in the usual old tables have not yet been adapted to the new knowledge of the physics of the earth's atmosphere. While astronomers formerly used the empirical method in studies of refraction, the present investigations are carried out analytically according to modern data and points of view. The results are discussed on hand [sic] of a special case of surveying practice.

The corrections for the normal refraction in the tables of the "Astronomisch-Geodaetisches Jahrbuch" and the differences in refraction as they, on the one hand, are actually prevailing during the observation of altitudes for sun azimuths and, on the other hand, are usually introduced according to the tables in the "Jahrbuch," proved to be substantial. The special computation of refraction or the anomalies from sounding data of the aerologic field can be carried out in a simple and economic manner.

DEUTSCHE GEODAETISCHE KOMMISSION BEI DER BAYERISCHEN AKADEMIE DER WISSENSCHAFTEN, Publications Series B: Applied Geodesy, No. 36 (German) AMS-GL-B664.2250, No. 36 (1957)-ms

493 *Method of Determining the Absolute Value of Level Variations.* (Módszer szintváltozások abszolút mértékének meghatározására.) László Bendefy

For determining level variations, the method generally used at present applies the elevations above sea level resulting from differently adjusted leveling nets. However, these elevations contain errors of measurement, mathematical errors originating from the adjustment, and actual variations of the base level.

The author proposes a new method for the elimination of these sources of error whereby the accuracy of the determination of the measure per unit of time of the level variations increases. This method consists of examining the variations not of the elevation of every bench mark, but of the elevation difference between two leveling datum points. This way of examination is more laborious, but it leads to absolute values. There is no need for orthometric or dynamic corrections, and the question of the difference of base levels between different leveling systems does not arise. Therefore, this method is very suitable for the geokinetic examination of leveling net in international relations.

GEOFIZIKAI KÖZLÖNY (Hungarian) AMS-GL-B661.5100, Vol. 5, No. 4 (1956)-af

501 *The Sea Level as the Elevation Reference* (Il livello del mare quale riferimento altimetrico). S. Polli

Elevation determinations are referred to the mean sea level of a local sea, assuming that such a mean sea level is constant. However, the mean sea level is not constant. It varies and at the present time it increases at a rate of 1.1 cm. each ten years.

Thus the reference surface becomes meaningless unless the following facts are taken into consideration: (1) the interval of time from which the mean sea level was obtained, (2) the central instant and (3) the vertical moment of the general mean sea level. By the vertical moment its velocity is understood and by the general mean sea level a mean sea level of all the seas is expressed.

Not only the mean sea level but the bench mark too is influenced by a slow vertical variation. Hence, elevations connected to it also vary in the course of time.

In order to improve the accuracy, a new method is suggested. The new method is based on the application of the general mean sea level. The general mean sea level has to be determined

on the basis of observations during a twenty-year period for each century. The corresponding general mean sea levels should refer to the central years of respective intervals.

The following advantages are listed: the surface reference level and the elevation of bench marks are determined in space and time; connections with other bench marks and terrestrial surfaces are more accurate; the mean sea levels correspond to the climatic measurements carried out all over the earth and in the same time intervals.

ANNALI DI GEOFISICA (Italian) AMS-QE501 R75, Vol. 10, No. 1/2 (1957)-ma

502 *A Comparison of Cadastral Surveys of Various Countries* (Raffronto fra i catasti dei diversi paesi). Prof. Nello Lupori

A comparison of cadastral surveys and service in various countries is presented and differences discussed.

The following countries were taken into consideration: France (with an emphasis on the utilization of aerial photography for cadastral purposes), Switzerland, Austria, Germany, Spain, Belgium, the Netherlands, Mexico, Burma, India, and Great Britain.

It is concluded the aerial survey is the most suitable one for cadastral purposes.

RIVISTA DEL CATASTO E DEI SERVIZI TECNICI ERARIALI (Italian) AMS-HD671 R62 Vol. 13, No. 2/3 (1958)-ma

503 *The New Italian Cadastral Public-Land Survey from its Initiation to its Completion* (Il Nuovo Catasto Italiano dei Terreni dal suo inizio al suo compimente). Tito Rumboldt

This issue of the *Rivista Del Catasto e Dei Servizi Tecnici Erariali* is dedicated to the completion of the new Italian cadastral public survey. The survey lasted for almost 70 years. It was completed in December of 1956.

The significance and importance of leading articles—dealing with the legislation, organization, and operational phases of the survey (Dr. F. Simonatti); various operational groups, planning staffs, etc. (Dr. G. Crosetti)—are explained.

The articles are full of details and provide the best historical background for a detailed study of the Italian cadastral operations and accomplishment.

RIVISTA DEL CATASTO E DEI SERVIZI TECNICI ERARIALE (Italian) AMS-HD671 R62, Vol. 12, No. 5/6 (1957)-ma

509 *Leveling and Gravity* (Nivellement und Schwere). C. F. Baeschlin

The necessity of gravity determination at a number of bench marks in precise leveling is explained in detail.

The nonparallelism of the verticals will exercise no influence on the measurements carried out in small areas, but in large areas this influence is important. A method is presented which uses not only the direction but also the value of gravity.

After a definition of the orthometric elevations, a method for their computation, based on a hypothesis, is presented.

The closing error in a perfect leveling should be zero, but if the nonparallelism of the reference surfaces is presupposed, this is not so. The error thus obatined is the theoretical closing error. For its computation formulae are given. However, if the geopotential heights are used in the adjustment of leveling, there is no need for the orthometric elevations. Various methods of establishing orthometric elevations are discussed in detail. The Swiss "user's elevations" applied by the Swiss Topographic Service in the national leveling are discussed at length. In 1944, all leveling lines had been reobserved, and the new adjustment was made. The theoretical closing errors of all loops were determined by finding the gravity at individual points of the leveling lines by means of an isogram. The isogram was based on the gravity determinations of the Swiss Geodetic Commission.

Geopotential elevations are not elevations, but approximate orthometric elevations and/or "user's elevations" can be derived from them.

SCHWEIZERISCHE ZEITSCHRIFT FUER VERMESSUNG, KULTURTECHNIK UND PHOTOGRAMMETRIE (German) AMS-GL-B644.7200, Vol. 56, No. 1/2 (1958)-ms/ma

511 *The Influence of Undeterminable Sources of Error in Time and Longitude Determinations* (Ueber den Einfluss nicht erfassbarer Fehlerquellen bei Zeit und Laengenbestimmungen). Paul Engi

Generally, the accuracy of time and longitude determinations derived from determinable errors is greater than that shown by observation results a posteriori. We deal not only with known sources of errors but also with sources which cannot be determined a priori.

An old study (1912–1929) of the accuracy of

the longitude determinations carried out by the Swiss Geodetic Commission has shown that there was better agreement in the observations made on consecutive nights than when an interruption of several days had occurred. This was ascribed to the influence of refraction among others. A recent study including not only the older data but those collected since 1929 as well and a table of the results are presented.

The following are the author's conclusions and comments based on the recent study: (1) a greater accuracy is obtained by radio chronometer comparison than by telegraphic; (2) the difference in accuracy depending on the interval between nights of observation can only be caused by the telegraphic chronometer comparison; (3) the effective velocity of the current is always smaller than the theoretical and subject to great fluctations; (4) the continuous star program—in the author's opinion—is superior to the group program; (5) the influence of refraction is greatest in mountainous areas; (6) the direct determination of longitudes is more economical than the observation of longitude differences.

FESTSCHRIFT C. F. BAESCHLIN (German) AMS-GL-B644.9002, (1957)-ms

525 *Analysis of a Leveling Survey Carried out with the Ni 2 Zeiss-Opton Level* (Analiza iz jednog nivelmana izvedenog sa nivelirom Ni 2 Zeiss-Opton). Veljko Petković

A line of 60 km. was leveled in both forward and backward directions with the Ni 2 Zeiss-Opton level. According to the manufacturer's data the accuracy of the first order leveling is ±2 mm/km. However, the mean error obtained in this leveling is

$$M = \pm \tfrac{1}{2}\,(1799.7/54) = \pm 2.8 \text{ mm/km.}$$

The mean accidental error obtained is

$$\eta = \pm 2.2 \text{ mm/km.}$$

The mean systematic error is

$$\sigma = \pm 2.6 \text{ mm/km.}$$

After a thorough analysis the differences between the obtained values and those given by the manufacturer are attributed to (a) leveling rods used in this survey, and (b) rugged terrain. However, by using the NI 2 Zeiss-Opton level the cost of survey was cut by 40–50%.

GEODETSKI LIST (Serbian) AMS-GL-B658.7100, Vol. 12, Nos. 1/2/3 (1958)-ma

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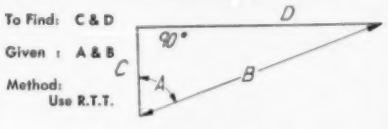

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Map Information

This department was inaugurated for the purpose of bringing to the attention of the members information pertaining to the availability of maps, surveys, etc., with particular emphasis on how such material can be procured. It is believed that through an interchange and dissemination of such information maximum benefits will accrue to the surveying and mapping profession. —EDITOR

Topographic Maps

THE FOLLOWING quadrangle maps were published or became available for distribution by the U. S. Geological Survey between March 1 and May 31, 1959. The list includes newly compiled maps; revised maps on which contours and drainage usually are unchanged but the works of man are brought up to date; and series-converted maps which are 15-minute maps produced from four 7½-minute maps of the same area. The maps are new unless otherwise designated by numerical superscript.

The quadrangle name (in capital letters) is followed by the name of the county (in upper- and lower-case letters) that contains the place or feature for which the quadrangle is named.

All maps are available with or without the green overprint that indicates woodland. These maps show the shape and elevation of the land surface (represented by contour lines, printed in brown—except those marked with the letter (P), which are planimetric); water features (in blue); works of man, including cities, towns, and scattered habitations, schools, churches, railroads, roads and boundaries, place and feature names (in black); and woodland areas (in green). Principal roads are shown by a red overprint. In areas that have been covered by Bureau of Land Management surveys, township and section lines are shown. The State rectangular coordinate and the UTM 1,000-meter grid systems are indicated in the margins of the maps. An information folder further describing topographic maps is available on request.

Standard quadrangle maps may be obtained for 30 cents per copy. A discount of 20 percent is allowed on orders amounting to $10 or more at the retail price; a discount of 40 percent is allowed on orders amounting to $60 or more. Orders should be addressed to the U. S. Geological Survey, Washington 25, D. C., (or Denver 15, Colo., for maps of areas west of the Mississippi River).

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* Indicates 15-minute quadrangles; all others are 7½-minute quadrangles.
[1] Indicates a revised map.
[2] Indicates a series-converted map.
† Indicates availability in either a contour or a shaded-relief edition.
‡ Indicates preliminary black and white edition.

Alabama

CAPSHAW—Limestone
FORT MORGAN—Baldwin
GRAND BAY—Mobile
HERON BAY—Mobile
ISLE AUX HERBES—Mobile
LITTLE DAUPHIN ISLAND—Mobile
MONTGOMERY*—Montgomery
MONTGOMERY NORTH—Montgomery
MONTGOMERY SOUTH—Montgomery
MOUNT MEIGS*—Montgomery
SELMA—Dallas
SELMA*—Dallas

Alabama-Mississippi

GRAND BAY*[2]—Mobile

Alabama-Tennessee

JEFF—Madison

Alaska

AMBLER RIVER A-4*
AMBLER RIVER A-5*
AMBLER RIVER A-6*
BEAVER A-1*
BEAVER A-2*
BEAVER A-3*
BEAVER A-4*
BEAVER A-5*
BEAVER B-1*
BEAVER B-2*
BEAVER B-3*
BEAVER B-4*
BEAVER B-5*
BIG DELTA A-1*
BLACK RIVER A-1*

BLACK RIVER D-1*
BLACK RIVER D-2*
BRADFIELD CANAL A-4*
BRADFIELD CANAL A-5*
BRADFIELD CANAL B-5*
CANDLE A-1*
CANDLE A-2*
CAPE MENDENHALL D-5*
CIRCLE A-1*
CIRCLE A-2*
CIRCLE A-4*
CIRCLE B-4*
CIRCLE C-2*
CIRCLE C-3*
CIRCLE C-4*
CIRCLE D-1*
CIRCLE D-3*
CIRCLE D-4*
COLEEN A-1*
COLEEN A-2*
COLEEN A-3*
COLEEN A-4*
COLEEN A-5*
COLEEN A-6*
COLEEN B-1*
COLEEN B-2*
FORT YUKON A-1*
FORT YUKON A-2*
FORT YUKON A-3*
FORT YUKON A-4*
FORT YUKON A-5*
FORT YUKON A-6*
FORT YUKON B-1*
FORT YUKON B-2*
FORT YUKON B-3*
FORT YUKON B-4*
FORT YUKON B-5*
FORT YUKON B-6*
FORT YUKON C-5*
FORT YUKON D-1*
GULKANA D-3*
HOLY CROSS A-1*
HOLY CROSS A-2*
HOLY CROSS A-3*
HOLY CROSS A-4*
HOLY CROSS A-5*
HOLY CROSS A-6*
HOLY CROSS B-1*
HOLY CROSS B-2*
HOLY CROSS B-3*
HOLY CROSS B-4*
HOLY CROSS B-5*
HOLY CROSS B-6*
HOLY CROSS C-1*
HOLY CROSS C-2*
HOLY CROSS C-3*
HOLY CROSS C-4*
HOLY CROSS C-5*
HOLY CROSS C-6*
HOLY CROSS D-1*
HOLY CROSS D-2*
HOLY CROSS D-3*
HOLY CROSS D-4*
HOLY CROSS D-5*
HOLY CROSS D-6*
HOOPER BAY A-2*
HOOPER BAY B-3*
HOOPER BAY C-3*
HOOPER BAY C-4*
KATEEL RIVER C-1*
KATEEL RIVER C-2*
KATEEL RIVER C-3*
KATEEL RIVER D-1*
KATEEL RIVER D-3*
KATEEL RIVER D-4*
KETCHIKAN A-3*
KETCHIKAN C-2*
KETCHIKAN C-3*
KETCHIKAN D-2*
KETCHIKAN D-3*
KETCHIKAN D-4*
MELOZITNA A-3*
MELOZITNA A-4*
MELOZITNA B-1*
MELOZITNA B-4*
MELOZITNA B-5*
MELOZITNA B-6*
MELOZITNA C-1*
MELOZITNA C-2*
MELOZITNA C-3*
MELOZITNA C-4*
MELOZITNA C-5*
MELOZITNA C-6*
MELOZITNA D-4*
MELOZITNA D-5*
MELOZITNA D-6*
MT. HAYES B-2*
NOATAK A-4*
NOATAK C-5*
NORTON BAY A-1*
POINT HOPE B-3*
POINT HOPE C-3*
POINT HOPE D-1*
PORT ALEXANDER B-3 & B-4*
PORT ALEXANDER C-3*
PORT ALEXANDER D-3*
PRINCE RUPERT D-3*
PRINCE RUPERT D-4*
PRINCE RUPERT D-5*
ST. MICHAEL A-5*
SHUNGNAK D-2*
SHUNGNAK D-3*
SHUNGNAK D-5*
SHUNGNAK D-6*
SKAGWAY A-2*
SKAGWAY A-3*
UNALAKLEET A-1*
UNALAKLEET A-2*
UNALAKLEET A-3*
UNALAKLEET A-4*
UNALAKLEET A-5*
UNALAKLEET A-6*
UNALAKLEET B-1*
UNALAKLEET B-2*
UNALAKLEET B-3*
UNALAKLEET B-4*
UNALAKLEET B-5*
UNALAKLEET B-6*
UNALAKLEET C-2*
UNALAKLEET C-3*
UNALAKLEET C-4*
UNALAKLEET C-5*
UNALAKLEET D-1*
UNALAKLEET D-2*

Arizona

BISBEE SE—Cochise
CANE SPRINGS*—Mohave
CANYON DEL MUERTO*—Apache
CORTARO*[1]—Pima
DOS CABESAS*[1]—Cochise
DOUBLE ADOBE—Cochise
DOUGLAS—Cochise
DRAGOON*[1]—Cochise
ELGIN[1]—Santa Cruz
FREDONIA*—Coconino
GLEASON SE—Cochise
HARSHAW[1]—Santa Cruz
HAY MOUNTAIN—Cochise
HUACHUCA VISTA[1]—Cochise
LOCHIEL[1]—Santa Cruz
LEUPP*—Coconino
LITTLEFIELD*—Mohave
LUZENA*[1]—Cochise
MOUNT LEMMON*—Pima
MUSTANG MOUNTAINS[1]—Santa Cruz
NOGALES*[1]—Santa Cruz
POTTER MOUNTAIN—Cochise
PYEATT RANCH—Cochise
SHORT CREEK*—Mohave
SONOITA[1]—Santa Cruz
SQUARETOP HILLS*—Cochise
WILLCOX*[1]—Cochise

Arizona-New Mexico

APACHE*—Cochise
BUELL PARK*—Apache
GUADALUPE CANYON*—Hidalgo
LUKACHUKAI*—Apache
SONSELA BUTTES*—Apache

Arkansas

ROGERS—Benton
SONORA—Washington

Arkansas-Missouri

PEA RIDGE—Benton

California

ALLEGHANY*[2]—Sierra
BLUE MOUNTAIN*—Calaveras
COLYEAR SPRINGS*[1]—Tehama
DEVILS HEART PEAK—Ventura
ELK CREEK*[1]—Glenn
GRANITE CHIEF*[2]—Placer
JELLICO*—Shasta
KNIGHTS LANDING*[2]—Yolo
LAKE HUGHES—Los Angeles
MARKLEEVILLE*—Alpine
McDONALD PEAK*[1]—Ventura
PROSPECT PEAK*—Shasta
RIO VISTA*[2]—Solano
SUTTER CREEK*[1]—Amador
WILLOWS*[2]—Glenn

Colorado

ALLENS PARK—Boulder
BOULDER—Boulder
CAMERON MOUNTAIN*—Chaffee
CATHEDRAL PEAK—Montrose
CONIFER—Jefferson
HARRIS PARK—Park
MERIDIAN HILL—Park
MILLIGAN LAKES—Park
MOUNT RICHTHOFEN—Grand
TRAIL MOUNTAIN—Grand
TRAIL RIDGE—Larimer

Florida

ALVA—Lee
ALVA SW—Lee
BOKEELIA—Lee
BONITA SPRINGS—Lee
CORKSCREW—Collier
CORKSCREW SE—Collier
ESTERO—Lee
FELDA NE—Hendry
FORT MYERS BEACH—Lee
IMMOKALEE NE—Collier
NAPLES NORTH—Collier
NAPLES SOUTH—Collier
OLGA—Lee
PORT ORANGE*—Volusia
SANIBEL—Lee
SEARS—Hendry
WULFERT—Lee

Georgia

CABRETTA INLET—McIntosh
DARIEN—McIntosh
DOBOY SOUND—McIntosh
ELBERTON*—Elbert
EULONIA—McIntosh
MACON*—Bibb
SAPELO SOUND—McIntosh
SHELLMAN BLUFF—McIntosh
THOMASVILLE*—Thomas

Hawaii

HONOKANE—Hawaii
HONULUA—Maui
LAHAINA—Maui
LUALAILUA HILLS—Maui
NAHIKU—Maui

Idaho

DONKEY HILLS*—Custer
DOUBLESPRING*—Custer
INITIAL POINT—Ada
HORSESHOE BEND—Boise
JEROME*[2]—Jerome
ROBERTS*[2]—Jefferson
SAND BASIN*—Owyhee
WILDER—Canyon

Idaho-Montana

EDIE RANCH*—Clark
NICHOLIA*—Lemhi
PAUL RESERVOIR*—Clark
SALTESE*—Mineral
SCOTT PEAK*—Lemhi
WALLACE*—Shoshone

Illinois

COLUMBIA[1]—Monroe
FRENCH VILLAGE[1]—St. Clair
MILLSTADT—St. Clair
NEW ATHENS EAST—St. Clair
PADERBORN—St. Clair

Illinois-Missouri

CAHOKIA[1]—St. Clair
GRANITE CITY[1]—Madison
VALMEYER—Monroe

Indiana
ALLENS CREEK[1]—Monroe
CLARKSBURG—Decatur
GARRETT—De Kalb
HUNTERTOWN—Allen
KIRKPATRICK—Montgomery
LINDEN—Montgomery
MAPLES—Allen
NEW ROSS—Boone
NORTH SALEM—Hendricks
PLYMOUTH—Marshall
SOUTH BEND EAST—St. Joseph
UNIONVILLE[1]—Monroe
WARSAW—Kosciusko
WATERLOO—De Kalb

Indiana-Kentucky
ALTON*—Crawford
CABORN—Posey
CORYDON*[2]—Harrison
WEST FRANKLIN—Posey

Iowa
COLESBURG—Delaware

Kansas
BENTLEY—Sedgwick
COLWICH—Sedgwick
DEVON—Bourbon
FORT SCOTT—Bourbon
LA CYGNE—Linn
MANTEYS—Linn
MARMATON—Bourbon
PATTERSON—Harvey
PLEASANTON—Linn
PRESCOTT—Linn

Kentucky
BIG CLIFTY*[2]—Hardin
ELIZABETHTOWN*[2]—Hardin
HARDINSBURG*—Breckenridge
VINE GROVE*[2]—Hardin

Kentucky-Indiana
EKRON*[2]—Meade
KOSMOSDALE*—Jefferson

Louisiana
BAYOU L'IVROGNE—Natchitoches
BELLE PASS—Lafourche
CAT ISLAND PASS—Terrebonne
CENTRAL ISLES DERNIERES—Terrebonne
COCODRIE—Terrebonne
EASTERN ISLES DERNIERES—Terrebonne
FOLSOM*—St. Tammany
FRANKLINTON*—Washington
LAKE ELOI—St. Bernard
LENA LAGOON—St. Bernard
PINE GROVE—St. Helena
POLLOCK*[1]—Grant
PROCTOR POINT—St. Bernard
WESTERN ISLES DERNIERES—Terrebonne

Louisiana-Mississippi
CLINTON*—East Feliciana
FELIXVLLE*—East Feliciana
ISLE AU PITRE—St. Bernard
MT. HERMON*—Washington

Maine
BAILEY ISLAND—Cumberland
CAMDEN—Knox
DIXFIELD*[1]—Oxford
FRIENDSHIP—Knox
HEWETT ISLAND—Knox
LINCOLN*[2]—Penobscot
LOUDS ISLAND—Lincoln
MATINICUS—Knox
MONHEGAN—Lincoln
NORTH WINDHAM[1]—Cumberland
ORRS ISLAND—Cumberland
PHIPPSBURG—Sagadohoc
PROUTS NECK[1]—Cumberland
SAPONAC*[1]—Penobscot
SMALL POINT[1]—Sagadohoc
TENANTS HARBOR—Knox
WATERVILLE*[2]—Kennebec
WEST ROCKPORT—Knox

Maryland
HEREFORD[1]—Baltimore

Minnesota
BASSWOOD LAKE*—Lake
DULUTH*[2]—St. Louis
ENSIGN LAKE*—Lake

Mississippi
LOGTOWN—Hancock

Mississippi-Alabama
GRAND BAY SW—Mobile
KREOLE—Jackson
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Missouri
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CEDAR HILL—Jefferson
CHESTERFIELD—St. Louis
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CREVE COEUR[1]—St. Louis
EUREKA—St. Louis
FLORISSANT—St. Louis
HERCULANEUM—Jefferson
KIRKWOOD[1]—St. Louis
O'FALLON—St. Charles
WELDON SPRING—St. Charles

Missouri-Illinois
OAKVILLE—St. Louis
WEBSTER GROVES[1]—St. Louis

Montana
THOMPSON FALLS*—Sanders

Montana-Idaho
HAUGAN*—Mineral
ILLINOIS PEAK*—Mineral

Nevada
BOULDER CITY SW—Clark
CHURCHILL BUTTE*—Lyon
COLD CREEK RANCH*—White Pine
FIREBALL RIDGE*—Churchill
NIXON*—Washoe
SILVER SPRINGS*—Lyon
SUTCLIFFE*—Washoe
TWO TIPS*—Washoe

New Hampshire
MT. KEERSARGE*[1]—Merrimack

New Hampshire-Massachusetts
HAVERHILL*—Essex

New Mexico
ARCH MESA—Valencia
CUBERO—Valencia
FOSTER RANCH—Eddy
GRANTS—Valencia
LOBO SPRINGS—Valencia
MESA GIGANTE—Valencia
MESITA—Valencia
MILAN—Valencia
SAN LORENZO*—Grant

New York
BALDWINSVILLE—Onondaga
BREWERTON[1]—Onondaga
CANASTOTA[1]—Madison
CICERO[1]—Onondaga
DUGWAY—Oswego
ELLENVILLE—Ulster
LACKAWACK—Ulster
MALLORY—Oswego
MAYBROOK—Orange
MIDDLETOWN—Orange
NEWBURGH—Orange
OTISVILLE—Orange
PEEKSKILL—Westchester
WAPPINGERS FALLS—Dutchess
WEST POINT—Orange

New York-New Jersey
CENTRAL PARK—New York

North Carolina
SEVEN SPRINGS*—Wayne
SHOOTING CREEK—Clay
TOPTON—Cherokee
WAYAH BALD—Macon

Ohio
DARBYVILLE—Pickaway
EAST RINGGOLD—Pickaway

Ohio-West Virginia
TILTONVILLE—Jefferson

Oklahoma
ALDEN—Caddo
APACHE—Caddo
ARBUCKLE HILL[1]—Comanche
BALLY MOUNTAIN—Kiowa
BOONE—Caddo
CYRIL—Caddo
DENTON—Stephens
ELGIN[1]—Comanche
FLETCHER—Comanche
FORT SILL[1]—Comanche
FRANCIS—Pontotoc
INDIAHOMA—Comanche
KONAWA—Seminole
LAVERTY—Grady
LAWTON—Comanche
LETITIA—Comanche
MEERS—Comanche
MOUNT SCOTT[1]—Comanche
NELLIE—Stephens
NINEMILE CREEK—Comanche
POST OAK CREEK—Comanche
QUANAH MOUNTAIN[1]—Comanche
RICHARDS SPUR—Comanche
ROCKY FORD—Grady
SADDLE MOUNTAIN—Comanche
SAPULPA SOUTH—Creek
STERLING—Comanche
TAUPA—Comanche
TUPELO NE—Coal
VAMOOSA—Seminole

Oklahoma-Texas
DENISON DAM*—Grayson
DURANT*—Bryan

Oregon
CHILOQUIN*—Klamath
ELK MOUNTAIN*—Wallowa
FOREST GROVE*—Washington
MAPLETON[1]—Lane
MONROE[1]—Benton
SLED SPRINGS*—Wallowa
SWAN LAKE*—Klamath

Oregon-Washington
WASCO*—Sherman
WISHRAM*—Klickitat

Pennsylvania
CARLISLE*[2]—Cumberland
ERIE SOUTH—Erie
LOYSVILLE*[2]—Perry
NEW BLOOMFIELD*[2]—Perry
NEW GALILEE—Beaver
NEWVILLE*[2]—Cumberland
PITTSBURGH WEST[1]—Allegheny
ZELIENOPLE—Butler

Puerto Rico
GURABO[1]—Humacao
NARANJITO[1]—San Juan

Rhode Island
NARRANGANSETT PIER[2]—Washington
NEWPORT[1]—Newport
PROVIDENCE[1]—Providence

South Carolina
GREER*[1]—Greenville
MONCKS CORNER—Berkeley
SUMMERVILLE—Dorchester

Tennessee
GOODLETTSVILLE[1]—Davidson
HERMITAGE[1]—Davidson
McFARLAND—Polk

Tennessee-North Carolina
BIG JUNCTION—Monroe
TELLICO PLAINS—Monroe
WHITE OAK FLATS—Monroe

Texas
DORCHESTER—Grayson
FANNETT EAST—Jefferson
HOWE—Grayson
LA FERIA[1]—Cameron
SHERMAN—Grayson
SHERMAN*[2]—Grayson
WHITESBORO*—Grayson

Texas-Oklahoma
BONHAM*—Fannin
DENISON DAM—Bryan
GORDONVILLE*—Grayson
WHITEWRIGHT*—Grayson

Utah
FACTORY BUTTE*—Wayne
PROVO*[2]—Utah

Utah-Arizona
JOHNSON*—Kane

Virginia
EAST STONE GAP—Wise
FARMVILLE*—Prince Edward
KEYSVILLE*—Charlotte
RICHMOND[1]—Henrico
SEVEN PINES[1]—Henrico

Virgin Islands
WESTERN ST. JOHN—St. John

Washington
BELLINGHAM SOUTH—Whatcom
CAPE FLATTERY*—Clallam
CARLISLE—Grays Harbor
COPALIS CROSSING—Grays Harbor
FORKS*—Clallam
MOUNT ST. HELENS*—Skamania
NORTH COVE—Pacific
NORTH NEMAH—Pacific
ORCAS ISLAND*[1]—San Juan
OROVILLE*—Okanogan

West Virginia
CLENDENIN—Kanawha
KENNA—Jackson
LAVALETTE—Wayne
MAMMOTH—Kanawha
WEST HAMLIN—Lincoln

West Virginia-Kentucky
BURNAUGH—Boyd

Wisconsin
WHITING* (P)—Portage
WISCONSIN DELLS*—Columbia

Wyoming
BOLTEN RANCH*—Carbon
BONNEVILLE SW[1]—Fremont
BUCKBOARD CROSSING*—Sweetwater
FIREHOLE BASIN*—Sweetwater
LOST WELLS BUTTE[1]—Fremont
MEXICAN PASS SE[1]—Fremont
MEXICAN PASS SW[1]—Fremont
PAVILLION[1]—Fremont
PAVILLION BUTTE[1]—Fremont
RAWLINS PEAK*—Carbon
RED CANYON[1]—Fremont
SAND DRAW[1]—Fremont
WAPITI*—Park

Yyoming-Utah
CURRENT CREEK RANCH*—Sweetwater

In addition to the standard series of quadrangle maps, small-scale (1:250,000) maps of areas in the United States and Territories are being published and distributed. They may be purchased from the Geological Survey for 50 cents per copy. An index to the series is available on request.

Alaska
AMBLER RIVER†
ARCTIC
HUGHES†
PORT ALEXANDER
SAINT MICHAEL
WISEMAN†

Georgia
ATHENS

Georgia-Florida
VALDOSTA

Kansas
WICHITA

Kansas-Oklahoma
DODGE CITY

Nevada
TONOPAH

Special metropolitan-area and vicinity maps of major United States cities are being published and distributed by the Geological Survey. These maps are prepared from standard 7½-minute maps at the scale of 1:24,000. Vicinity maps may be purchased from the Geological Survey for the prices indicated below.

DENVER AND VICINITY (50 by 68 inches) $1.50.
NORFOLK, PORTSMOUTH, NEWPORT NEWS AND VICINITY (50 by 72 inches) $1.50.

State maps are also being published and distributed. These maps may be purchased from the Geological Survey for the prices indicated below.

#KENTUCKY (relief). (27 by 58 inches) 1:500,000 scale. $2.
#TENNESSEE (base). 35 by 11 inches) 1:1,000,000 scale. 20¢.
#TENNESSEE (base). (19 by 65½ inches) 1:500,000 scale. $1.
TENNESSEE (topographic). (19 by 65½ inches) 1:500,000 scale. $2.

# Indicates that map does not show contours.

The following National Park maps are now available:

ISLE ROYALE NATIONAL PARK, MICHIGAN (woodland edition). (39 by 54 inches) 1:62,500 scale. $1.50.
ISLE ROYALE NATIONAL PARK, MICHIGAN (shaded relief edition). (39 by 54 inches) 1:62,500 scale. $1.50.
CRATERS OF THE MOON NATIONAL MONUMENT, IDAHO.[1] (24 by 33 inches) 1:31,680 scale. 50¢.

Lake Survey Charts

PUBLICATION of new editions of the following Lake Survey Charts has been announced by the United States Lake Survey of the Corps of Engineers, U. S. Army. Copies of these charts may be obtained from the U. S. Lake Survey, 630 Federal Building, Detroit 26, Mich., at 75 cents per copy. Payment is required in advance by P. O. money order or draft, payable to the Treasurer of the United States. A catalog showing the areas described below is available free upon request.

11.—St. Lawrence River Chart. St. Regis, Quebec, to Croil Islands, N. Y., at 1 : 30,000 scale. (May 1959)

12.—St. Lawrence River Chart. Croil Islands to Leishman Point, N. Y., at 1 : 30,000 scale. (April 1959)

13.—St. Lawrence River Chart. Leishman Point to Ogdensburg, N. Y., at 1 : 30,000 scale. (May 1959)

14.—St. Lawrence River Chart. Ogdensburg, N. Y., and Prescott, Ont., at 1 : 15,000 scale. (April 1959)

15.—St. Lawrence River Chart. Holmes Point, N. Y., to Deer Island, N. Y., at 1 : 30,000 scale. (April 1959)

16.—St. Lawrence River Chart. Whiskey Island Shoal to Bartlett Point, N. Y., at 1 : 30,000 scale. Inset : Clayton, N. Y., and Alexandria Bay, N. Y., at 1 : 10,000 scale. (April 1959)

17.—St. Lawrence River Chart. Bartlett Point, N. Y., to Cape Vincent, N. Y., at 1 : 30,000 scale. Inset : Cape Vincent, N. Y. at 1 : 10,000 scale. (April 1959)

18.—St. Lawrence River Chart. Cape Vincent, N. Y., to Allan Otty Shoal, N. Y., and Kingston, Ont., at 1 : 30,000 scale. (April 1959)

22.—Lake Ontario Coast Chart. Six miles south of Stony Point, N. Y., to 8 miles west of Little Sodus Bay, N. Y., at 1 : 80,000 scale. Inset : Little Sodus Bay, N. Y., at 1 : 15,000 scale. (March 1959)

23 :—Lake Ontario Coast Chart. Eight miles east of Sodus Bay, N. Y., to Rochester Harbor, N. Y., at 1 : 80,000 scale. (April 1959)

24.—Lake Ontario Coast Chart. Braddock Point, N. Y., to Thirty Mile Point, N. Y., at 1 : 80,000 scale. (April 1959)

36.—Lake Erie Coast Chart. Vermilion, Ohio to Port Clinton, Ohio, and Point Pelee, Ont., to Colchester, Ont., at 1 : 80,000 scale. (April 1959)

43.—St. Clair River Chart. St. Clair Flats to foot of Lake Huron, at 1 : 40,000 scale. Inset : Head of St. Clair River at 1 : 15,000 scale. (May 1959)

113.—St. Lawrence River Chart. Morristown, N. Y., to Union Park, Ont., at 1 : 15,000 scale. (April 1959)

114.—St. Lawrence River Chart. Union Park, Ont., to Ironsides Island, N. Y., at 1 : 15,000 scale. (May 1959)

115.—St. Lawrence River Chart. Ironsides Island, N. Y., to Bingham Island, Ont., at 1 : 15,000 scale. (April 1959)

116.—St. Lawrence River Chart. Gananoque, Ont., to St. Lawrence Park, N. Y., at 1 : 15,000 scale. (April 1959)

117.—St. Lawrence River Chart. Round Island, N. Y., and Gananoque, Ont., to Wolfe Island, Ont., at 1 : 15,000 scale. (May 1959)

172.—Lake Champlain. Cumberland Head, N. Y., and Savage Island, Vt., to Four Brothers Islands, at 1 : 40,000 scale. (March 1959)

225.—Oswego Harbor, N. Y., at 1 : 10,000 scale. (March 1959)

234.—Sodus Bay, N. Y., at 1 : 10,000 scale. (March 1959)

238.—Rochester Harbor, N. Y., including Genesee River to head of navigation, at 1 : 10,000 scale. (March 1959)

354.—Cleveland Harbor, Ohio, including lower Cuyahoga River, at 1 : 10,100 scale. (March 1959)

363.—Huron Harbor, Ohio, at 1 : 5,000 scale. (March 1959)

374.—Toledo Harbor, Ohio. Lower Maumee Bay and the Ottawa River at 1 : 20,000 scale. Inset : Entrance channel to the harbor at 1 : 40,000 scale. (February 1959)

376.—Monroe Harbor, Mich., at 1 : 20,000 scale. (March 1959)

1959 Great Lakes Pilot including complete set of seven monthly Supplements (May through November). $3.25.

Public Land Survey Plats

THE FOLLOWING plats of public land surveys and resurveys were completed and accepted by the Bureau of Land Management between March 1 and May 31, 1959. The class or purpose of the survey is indicated. Copies of plats may be secured from the Bureau offices in the States or from the Director, Bureau of Land Management, Department of the Interior, Washington 25, D. C.

Alaska

U. S. Survey No. 3470—Chiniak Bay Small Tract Group
U. S. Survey No. 3471—Chiniak Bay Small Tract Group
U. S. Survey No. 3472—Chiniak Bay Small Tract Group
U. S. Survey No. 3473—Chiniak Bay Small Tract Group
U. S. Survey No. 3474—Chiniak Bay Small Tract Group
U. S. Survey No. 3511—Small tracts near Kodiak
U. S. Survey No. 3512—Small tracts near Kodiak
U. S. Survey No. 3545—Small tracts, Douglas Island
U. S. Survey No. 3546—Small tracts, Douglas Island
U. S. Survey No. 3550—Chitina Municipal Airport
U. S. Survey No. 3589—Monti Bay Small Tracts
U. S. Survey No. 3590—Monti Bay Small Tracts

Alaska—Copper River Meridian

T. 28 S., R. 54 E.—Extension survey

Alaska—Seward Meridian

T. 20 N., R. 8 E.—Extension survey
T. 17 N., R. 4 W.—Extension survey
T. 8 N., R. 10 W.—Extension survey
T. 8 N., R. 11 W.—Extension survey

Alaska—Fairbanks Meridian

T. 1 S., R. 2 E.—Extension survey

Arizona—Gila and Salt River Meridian

T. 3 N., R. 3 W.—Extension survey
T. 16½ N., R. 11 W.—Extension survey
T. 17 N., R. 11 W.—Extension survey
T. 5 S., R. 5 E.—Extension survey
T. 4 S., R. 14 E.—Dependent resurvey

California—Mount Diablo Meridian

T. 31 N., R. 7 W.—Dependent resurvey, part of boundaries
T. 48 N., R. 9 W.—Dependent resurvey, part of subdivision
T. 47 N., R. 10 W.—Dependent resurvey, part of boundaries
T. 48 N., R. 10 W.—Dependent resurvey, all township

Colorado—Sixth Principal Meridian

T. 1 N., R. 101 W.—Dependent resurvey and subdivisional survey

Florida—Tallahassee Meridian

T. 18 S., R. 16 E.—Island survey, section 5

Louisiana—Louisiana Meridian

T. 17 N., R. 10 W.—Extension survey

Minnesota—Fourth Principal Meridian

T. 58 N., R. 7 W.—Omitted land survey, section 30
T. 65 N., R. 20 W.—Island survey, section 22
T. 61 N., R. 24 W.—Island survey, sections 16 and 21
T. 62 N., R. 25 W.—Island survey, section 10

Minnesota—Fifth Principal Meridian

T. 113 N., R. 28 W.—Island survey, section 29

Montana—Principal Meridian

T. 17 N., R. 19 E.—Dependent resurvey, section 5
T. 17 N., R. 20 E.—Dependent resurvey, section 19
T. 6 S., R. 4 E.—Dependent resurvey, part of subdivision
T. 2 S., R. 29 E.—Dependent resurvey, part of subdivision

Nebraska—Sixth Principal Meridian

T. 29 N., R. 13 W.—Dependent resurvey, part of subdivision
T. 30 N., R. 13 W.—Dependent resurvey, all township
T. 31 N., R. 13 W.—Dependent resurvey, all township
T. 32 N., R. 13 W.—Dependent resurvey, part of subdivision
T. 30 N., R. 14 W.—Dependent resurvey, all township
T. 31 N., R. 14 W.—Dependent resurvey, part of subdivision
T. 31 N., R. 15 W.—Dependent resurvey, all township

Nevada—Mount Diablo Meridian

T. 45 N., R. 38 E.—Dependent resurvey, all township
T. 46 N., R. 38 E.—Dependent resurvey, all township
T. 47 N., R. 38 E.—Dependent resurvey, all township
T. 48 N., R. 38 E.—Dependent resurvey, all township
T. 22 S., R. 58 E.—Dependent resurvey, all township
T. 19 S., R. 59 E.—Subdivision of sections
T. 20 S., R. 59 E.—Subdivision of sections
T. 21 S., R. 59 E.—Subdivision of sections
T. 3 S., R. 60 E.—Survey, part of township
T. 19 S., R. 60 E.—Subdivision of sections
T. 20 S., R. 60 E.—Subdivision of sections
T. 21 S., R. 60 E.—Subdivision of sections
T. 22 S., R. 60 E.—Subdivision of sections
T. 21 S., R. 61 E.—Subdivision of sections

New Mexico—New Mexico Principal Meridian

T. 26 N., R. 6 W.—Dependent resurvey, all township
T. 4 N., R. 7 W.—Dependent resurvey, all township
T. 4 N., R. 8 W.—Dependent resurvey, all township
T. 23 S., R. 1 E.—Dependent resurvey, part of township
T. 1 S., R. 19 W.—Dependent resurvey, section 18
T. 5 S., R. 19 W.—Dependent resurvey, part of township

North Dakota—Fifth Principal Meridian

T. 149 N. R. 58 W.—Dependent resurvey, part of township
T. 150 N., R. 58 W.—Dependent resurvey, part of township
T. 149 N., R. 59 W.—Dependent resurvey, part of township
T. 150 N., R. 59 W.—Dependent resurvey, part of township
T. 150 N., R. 60 W.—Dependent resurvey, part of township
T. 150 N., R. 61 W.—Dependent resurvey, part of township
T. 151 N., R. 61 W.—Dependent resurvey, part of township

Oregon—Willamette Meridian

T. 36 S., R. 2 E.—Dependent resurvey, part of township
T. 37 S., R. 2 E.—Dependent resurvey, part of township
T. 38 S., R. 3 E.—Dependent resurvey, part of township
T. 5 S., R. 4 E.—Dependent resurvey, part of township
T. 9 S., R. 4 E.—Dependent resurvey, part of township
T. 38 S., R. 4 E. (2)—Dependent resurvey, part of township
T. 13 S., R. 28 E.—Dependent resurvey, part of township
T. 33 S., R. 1 W.—Dependent resurvey, part of township
T. 27 S., R. 2 W.—Dependent resurvey, part of township
T. 7 S., R. 6 W.—Dependent resurvey, part of township
T. 33 S., R. 7 W.—Dependent resurvey, part of township
T. 39 S., R. 7 W.—Dependent resurvey, part of township
T. 40 S., R. 8 W.—Dependent resurvey, part of township

Utah—Salt Lake Meridian

T. 41 S., R. 13 W.—Dependent resurvey, part of township
T. 41 S., R. 14 W.—Dependent resurvey, part of township

Wyoming—Sixth Principal Meridian

T. 44 N., R. 60 W.—Dependent resurvey, all township

County General Highway Maps

THE FOLLOWING county general highway maps were received by the U. S. Bureau of Public Roads, Washington, D. C., during the period from March 11 to May 29, 1959. Copies of these maps are sent to the Washington office as part of the continuing cooperative Federal-State highway planning program, as they are completed or revised by the State highway departments.

Inquiries concerning prices and orders should be sent to the respective State highway departments and not to the U. S. Bureau of Public Roads.

Alabama

COLBERT
HENRY
LIMESTONE

Arkansas

CHICOT

Georgia

CAMDEN
COOK
DODGE
HABERSHAM
LANIER
LOWNDES
McINTOSH
MORGAN
RICHMOND
TALIAFERRO
TERRELL
TREUTLEN

Illinois

BROWN
CHRISTIAN
DU PAGE
MADISON

Iowa

CASS
CLAYTON
DECATUR
DELAWARE
GREENE
HARDIN
JASPER
JOHNSON
MAHASKA
MONROE
RINGGOLD
UNION
VAN BUREN

Kansas

ANDERSON
CHEROKEE
DICKINSON
DOUGLAS
HARVEY
LYON
MIAMI
MORRIS
NEOSHO
SHERIDAN
TREGO
WALLACE

Louisiana

CADDO
CAMERON
EAST FELICIANA
IBERIA
ST. CHARLES
ST. HELENA
ST. JOHN THE BAPTIST
TERREBONNE
WEST FELICIANA

Minnesota

KITTSON
MARSHALL
NORMAN
POLK
ROSEAU

Mississippi

CLARKE
COVINGTON
GREEN

JASPER
JONES
PERRY
SMITH
WAYNE

Missouri

BUTLER
CARTER
CEDAR
DAVIESS
DUNKLIN
FRANKLIN
IRON
JEFFERSON
MADISON
MONITEAU
OSAGE
PUTNAM
RIPLEY
SALINE
SULLIVAN
TEXAS
WASHINGTON

Montana

DEER LODGE
MISSOULA

Nebraska

CHERRY

New Mexico

DE BACA
ROOSEVELT

North Dakota

EDDY
EMMONS
KIDDER
PIERCE
RAMSEY
TOWNER

Ohio

ADAMS
LORAIN
NOBLE
TRUMBULL

Oregon

JACKSON

South Dakota

DEWEY

HAAKON
JACKSON
ZIEBACH

Tennessee

DICKSON
HICKMAN
HOUSTON
HUMPHREYS
LEWIS
MONTGOMERY
PERRY
STEWART

Utah

UTAH

Washington

FRANKLIN

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News of Related Organizations

Wisconsin Society of Land Surveyors

The officers and directors of the Wisconsin Society of Land Surveyors for 1959 are as follows:

President—Thomas W. Phipps,

Vice President—Roger W. Mueller,

Secretary-Treasurer—Robert L. Smith,

Directors—Foster S. Curtiss, Richard H. Batterman, Jr., and David C. Knoerr,

Past Presidents—Franklin P. Gould and George E. Phillips.

The 1959 directory of the Society gives the new address of the Secretary-Treasurer as 839 63rd Place, Kenosha, Wisconsin. This directory shows that the Society now has 146 members and 19 affiliated members.

Indiana Society of Professional Land Surveyors

The following items from the June 1959 issue of the *Surveying and Mapping Newsletter,* issued by the Indiana Society of Professional Land Surveyors—Division of Adult Education, Purdue University, Lafayette, Indiana—Ken S. Curtis, Editor, have been reprinted in the belief that they will be of interest generally to readers of SURVEYING AND MAPPING —EDITOR

FHA-VA and Flooding in Suburban Developments

By M. CLIFFORD BOYER

Because of the rapidly increasing demand for suburban housing, developers are being attracted to tracts of land which lie along or athwart surface drainage systems that may flood these areas. The Federal Housing and Veterans Administrations recognize this danger, and it is now their policy not to accept financial responsibility for any such proposed development until it is examined and a statement regarding flooding potentialities is made by the Indiana Flood Control and Water Resources Commission.

It is a part of the duties of the land surveyor who is hired to plot a housing or industrial development to advise his client if flooding may occur. Not to do so may result in homes being built in areas subject to flooding, endangering both property and lives and committing what almost amounts to an act of criminal negligence.

The Indiana Flood Control and Water Resources Commission has gathered, and is continuing to gather, a wealth of information on flood heights and discharges along all the major and many of the minor streams in the State. These data are available as a public service.

The Federal Housing Administration, as described above, requires the developer to submit certain data to the Commission when in their opinion a flood hazard may be present. These include:

a. A plat or location plan in sufficient detail so that the exact location may be transferred to a topographic quadrangle or city or county map.

b. A topographic map of the area, with contours referred to mean sea level.

c. A plan of any proposed surface drainage channel, including a plat of the cross section and a stream profile and a computed channel capacity.

d. Cross sections of bridges or culverts, showing shape and size of opening and elevation of invert and under structure.

The Commission is not concerned with storm drainage except insofar as it affects channel capacities. The storm drainage pattern should be outlined and outflow rates indicated.

If information relating to location of bench marks or availability of any other data is required, write: Indiana Flood Control and Water Resources Commission, 1330 West Michigan Street, Indianapolis 7, Indiana.

Monument at Initial Point Authorized

The Indiana General Assembly has authorized the acquisition of suitable real property to provide for a suitable historical monument at the intersection of the base line and the second principal meridian, a roadside park on State Road 37, and a fifty-foot-right-of-way access road leading from the park area to the historical monument area.

House Bill 212—An act to appropriate $7,800.00 to erect two monuments and make

a roadside park at the intersection of the second principal meridian and base line in Orange County.

This act was passed by the House and Senate and was signed by the Governor although the Ways and Means B Committee paired the appropriation down to $1,000.00.

Election of Officers

At the annual business meeting of the ISPLS in January the following officers were elected for the year 1959:

President—George A. Crowder, Columbus
President Elect—C. B. Wood, Angola
Vice President—Joseph W. Jacobi, Clarksville
Secretary-Treasurer—Owen C. Smith, Jr., Fort Wayne
Executive Secretary—Ken S. Curtis, West Lafayette
Directors: 1959–60–61—James E. Dankert, Indianapolis; Adolph K. Hofer, Fort Wayne: 1959–60—Arthur F. Buerkle, Lafayette; Harold E. Norris, Peru (replaces Frank White): 1959—Robert A. Krull, Hobart; Richard A. Long, Indianapolis.

Annual Land Surveyors Conference

Slightly over one-hundred land surveyors attended the 7th Annual Conference held on the Purdue University campus in January and were well paid for their attendance. The dates for next year's meeting have been set as Thursday, Friday, and Saturday, January 14, 15, and 16, 1960. Those attending this year's meeting indicated a desire to have a special one-day short course preceding the regular Friday and Saturday meeting on a special topic such as "Astronomic Observations For Azimuth," "State Plane Coordinate System," or "Mathematics for the Land Surveyor," etc.

Approximately fifteen papers which have been presented during the past two conferences are now being reviewed and edited and will be published later this summer or early in the fall.

The Joint Highway Research Project (a joint venture between the State Highway Department and Purdue University) has purchased a Tellurometer. It will be used in research and teaching at the University and will be used by the highway department and other State agencies in field work.

The Civil Engineering School at Purdue University was the recipient of a gift of surveying equipment and surveying books from the estate of the late Arthur D. Kidder of Terre Haute. Dr. Kidder's three solar transits were sold by the estate, and Purdue was fortunate to be able to purchase one of them.

Georgia Association of Registered Land Surveyors

The regular monthly business meeting of the Georgia Association of Registered Land Surveyors was held Saturday, June 6, 1959, at the Architects-Engineers Building in Atlanta, Ga. The GARLS Annual Summer Outing was held on Saturday, July 11, 1959, at Pine Mountain (Chipley), Ga.

East Bay Council on Surveying and Mapping [1]

The East Bay Council on Surveying and Mapping, of Contra Costa and Alameda Counties in California's San Francisco Bay area, an affiliate of ACSM, held its March 11, 1959, meeting at the City Hall in Richmond, with General Chairman R. B. Hurd presiding. More than twenty survey engineers represented sixteen municipal, county, State, and Federal surveying and mapping agencies in cooperative council on the area's surveying problems.

Reports of various technical committees were reviewed. Report No. 14 on *Map Index* was accepted subject to addition of a zone reference so that Report No. 14 can be distributed. *Coordinates in Deeds and on Maps* were discussed under Report No. 16. Report No. 19 on *Secondary Monuments* was accepted as approved in 1954 and modified in 1955. Report No. 21 on *Discrepancies Discovered Relating to Record Maps* was reviewed. The review raised the question of the term *discrepancy* not perhaps being as appropriate as the term *error* or *mistake,* with the thought that discovered errors should be brought to attention of proper authority. A more complete report on *Analytical Method of Adjustment of Control Stations,* Report No. 22, will be prepared for distribution at the next Council meeting.

A "neo-flasher" triangulation-target light was demonstrated. This is a two-inch dome lens, battery powered, producing brilliant flashing light, open and nondirectional, visible 4 to 6 miles at night and ½ mile in daytime. Using 12 volts (two standard 6-volt railroad cells) with a 7-volt bulb, the bulb life exceeds the battery life of about 40 to 60 hours. Flash rate

[1] Abstracted from minutes of EBCSM Secretary J. D. Kelly by Walter S. Dix.

is fixed but can be varied at the factory. L-shaped housing facilitates mounting over a point. White, amber, and red lenses are available at less than a dollar each. Without batteries, the light is sold by its maker[2] for about $30.

The City of Richmond's mapping program, utilizing standard scales of 1000, 100, and 50 feet to the inch as recommended in the Council's Technical Report No. 17, is reported progressing satisfactorily. Cooperation with other organizations has been enjoyed. Adjustment of the horizontal control network is completed, following prior adjustment of the basic USC &GS control.

[2] Neo-Flasher Mfg. Co., 90 Hegenberger Loop, Oakland, Calif.

Kansas Society of Land Surveyors

The 1959 annual meeting of the Kansas Society of Land Surveyors will be held at the Broadview Hotel in Wichita on Friday, October 23, and Saturday, October 24. The Wichita Chapter of KSLS will be the host at this meeting.

All surveyors are invited to participate in the program, whether or not they are members of KSLS and whether or not they are residents of Kansas. An interesting group of speakers and topics of interest, in general, to surveyors is promised.

—James L. Bell
President, KSLS

Corporation des Arpenteurs-Géomètres de la Province de Québec

The 76th Annual Meeting of the Corporation des Arpenteurs-Géomètres de la Province de Québec was held this year on June 1 to 3 at the Seigniory Club, Montebello, Quebec.

ACSM was represented at this important annual meeting of one of the oldest and most honored surveyors' associations on this continent by Lester C. Higbee, Past President of ACSM, and A. Phillips Bill, Chairman of the Property Surveys Division of ACSM. Among other guests were: S. G. Gamble, Chief of the Topographic Survey of Canada; R. Thistlethwaite, Surveyor-General of Canada: and R. F. Mucklestone, President of the Association of Ontario Land Surveyors.

The meeting was ably chaired by M. Armond Dumas, M.P., Q.L.S., who this year holds the distinction of being president of both the Quebec Corporation and the Canadian Institute of Surveying.

Many able committee reports were heard, the most notable of which was that of the Fees and Salaries Committee, under the chairmanship of M. Marc Dancose. This report, 26 pages in length, presented a thorough analysis of conditions, past and present, and an entirely new schedule of professional fees.

—A. Phillips Bill

Joint Meeting at Santa Rosa

The Sonoma, Lake, and Mendocino Counties Civil Engineer's and Land Surveyor's Association and the Northern California Section, ACSM, held a joint meeting on Friday, May 15, 1959, at the Hotel Santa Rosa, Santa Rosa, Calif. Thirty-five members of these organizations and their wives attended.

L. G. Hughes, President of the Tri-County Association presided over the opening of the meeting and the election of new officers of that organization which followed. Thomas L. O'Connor of Lower Lake was elected President; Thorne Holmes of Fort Bragg, Vice President; and Quintin Campbell of Santa Rosa, Secretary-Treasurer.

William Angeloni, Chairman of the Northern California Section, ACSM, introduced Prof. C. J. Aggeler of the City College of San Francisco. Professor Aggeler spoke on surveyor education and the methods and standards of licensing surveyors in California.

The second speaker, James P. Brennan of San Francisco, read a letter report on San Francisco property surveys, written by James Waite, regarded by many as the dean of San Francisco property surveyors.

Joseph Smithwick, who for many years worked in the San Francisco City Engineer's Office and with private San Francisco surveyors and has a wealth of detailed information concerning downtown street centerlines and property corners, presented many interesting anecdotes of the results of the 1906 earthquake.

Vice Chairman Paul J. Dowling, Northern California Section, described the Tri-County Association's tape range, located on the grounds of the Sonoma County Administration Building, explaining in detail how the equipment is operated.

—Quintin Campbell
Secretary-Treasurer
Tri-County Association

San Joaquin Valley Surveyors Conference

The San Joaquin Valley Surveyors Conference, sponsored jointly by the Northern California Section, ACSM, and the Engineering Department of Fresno State College, was held on March 27 and 28, 1959, on the campus of Fresno State College. The conference brought together more than two hundred and thirty men and women interested in surveying from all segments of the profession and all parts of the State.

After a welcome by Herbert H. Wheaton, Dean of Arts and Science, Fresno State College, the technical session was opened by William Angeloni, Chairman of the Northern California Section.

The speakers for the first morning included Arthur Paoli of Keuffel & Esser Co., who spoke on the "Care and Use of Surveying Instruments," and Albert Cocking, Chairman of the Southern California Section, ACSM, whose topic, "Tellurometer and Geodimeter in Modern Surveying," created such interest that the question and answer session which followed had to be continued into the afternoon.

George Katibah, California Division of Highways, opened the afternoon session with the reading of a paper written by Wililam A. White (who could not be present because of illness) on "The National and State Picture on Status of Surveying and Engineering." A panel discussion on "Boundary Surveying," moderated by Samuel Black, Director of Public Works, Fresno County, evoked considerable interest in a subject dear to the hearts of all surveyors. The panel members and their subjects were: Samuel Black—deed descriptions from the county surveyor's viewpoint, Walter Hanna —"Retracement Surveys and Surveyors," and Glen F. Myers—"Best Available Evidence."

Charles A. Wooldridge, serving as chairman for the second day, introduced the moderator of a panel on "Photogrammetric Mapping," L. L. Funk, California Division of Highways. The panel members—Clyde Sunderland, William S. Robinson, Charles Greenwood, Hugh Gallaher, and Harl Pugh—very ably brought those in attendance through the entire process of photogrammetric mapmaking from the taking of the aerial photographs to the printing of the maps.

The remainder of the morning session was given to a report by E. F. Kulhan on the recipients of the seven surveying scholarships established by the 1958 Conference. The 1959 Conference voted to award scholarships to the following eight schools: Bakersfield College, Taft College, Porterville Junior College, Coalinga College, Fresno City College, Fresno State College, Reedley College, and San Francisco City College.

The second afternoon session was given over to the Surveyors Clinic, the popularity of which is attested by the large number of requests that this portion of the program be expanded to a full day in future conferences. The following fifteen subjects were covered in the clinic:

Transit Setup and Operation, Notekeeping and Note Reduction—Prof. C. J. Aggeler

Level Setup and Operation, Notekeeping and Note Reduction—Frank Gress

Taping, Horizontal and Slope, Notes and Note Reduction—G. W. Gilbert

Tape Corrections—Ernest Wolf

Precise Levels and Notes—Prof. C. J. Aggeler

Subtense Bar, Observations and Notes—William Richards and Robert McBroome

Traverse Computations and Adjustments—William C. Wattles

California Grid System, Computations and Use in Problem Solving—William Curnutte

Map Reading—Glen Myers

Property Description, "Order of Importance of Deed Elements for Property-Line Surveys"—Curtis M. Brown

Plat Requirements—William Gentry

Instrument Adjustment—Arthur Paoli

Field Demonstration of Tellurometer—Albert Cocking

Field Demonstration of Todis Range Finder—Robert Skaggs

Field Demonstration of Height Measuring Instruments—J. W. Huckaby and Charles W. Meehan

At a well attended dinner, held at the Hotel Californian on the evening of the first day, Prof. Carl Swensen of Fresno State College, a member of the Fresno City Planning Commission, spoke on "A Non-Engineer's View of City Planning."

—Edward F. Kulhan
General Conference Chairman

South Carolina Society of Registered Land Surveyors

The summer meeting of the South Carolina Society of Registered Land Surveyors was held Saturday, July 18, 1959, at the Wade Hampton Hotel in Columbia. An interesting program was conducted by W. H. Matheny, Charleston, S. C., on the March meeting of the American

Congress on Surveying and Mapping, which he attended in Washington, D. C.

The following officers and directors were elected:

President—W. B. Sykes, Manning
Vice President—David G. Casey, Anderson
Secretary-Treasurer—William Wingfield, Columbia
District Directors—
W. H. Matheny, Charleston
J. Coke Smith, Easley
William C. White, Rock Hill
Other *Directors* are—
Cody Palmer, Sumter
H. M. Pickwell, Greenville
John D. Brockington, Kingtree

Annual Convention, A.S.C.E.

The newsletter *The Civil Engineer* of the National Capital Section, American Society of Civil Engineers, for August 1959 states that the Annual Convention of the A.S.C.E. will be held in Washington, D. C., October 19–23, 1959, with headquarters at the Statler-Hilton Hotel.

The American Congress on Surveying and Mapping has a very direct interest in the success of that convention, because many ACSM members are on the various ASCE convention committees.

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Bay Bags Buck

Helmuth Bay, Rand McNally's Washington representative, who is Chairman of the Public Relations Committee, ACSM, suddenly, while driving through the Shenandoah National Park on Monday, August 10, 1959, with Wesley Dennis of Warrenton, Virginia, found a six-point buck deer in his lap. The startled deer leaped through the windshield of their station wagon, smashing it and killing the deer. Both men were cut by splintered glass. The car's hood, roof, and steering wheel were damaged.

"The Chartered Surveyor"

The Chartered Surveyor is the Journal of the Royal Institution of Chartered Surveyors, 12 Great George Street, Parliament Square, Westminster SW 1, London, England. ACSM has recently effected an exchange of Journals between the two organizations, RICS to receive SURVEYING AND MAPPING and ACSM to receive *The Chartered Surveyor.*

The July 1959 issue of *The Chartered Surveyor,* Vol. 92, No. 1, was the first issue received by ACSM. It is briefly reviewed, as follows:

The format is 8½ by 11, with a two-column makeup, running about 50 pages, seven of which, inside and back covers, contain advertisements.

The Journal devotes a few pages to the President's message, editorial notes, council proceedings, general items, Institute notices, and personals, followed by regular departments on: Agriculture and Forestry; Valuation-Housing-Planning; Building and Quantity Surveying; Land Surveying and Mining Surveying; Parliamentary and General; and Junior Organisation Quarterly.

The individual issue carries no title page or index. Articles in this July issue, contained appropriately within their respective departments, are as follows: The President; Editorial Notes; Council Proceedings; Life Members of Council; Architects' Fees for work in connection with Private Housing Development; Institution Notices; Personal Announcements; Town Planning Joint Examination Board. Under the departments there are: (Agriculture and Forestry) The Air Seasoning of Timber; (Valuation-Housing-Planning) Lands Tribunal Decisions; (Building and Quantity Surveying) The Role of the Quantity Surveyor During the Design Stage; Cost Research Panel (Housing by Trades); Quantity Surveyors Committee Minutes; Building Announcements and Publications; (Land Surveying and Mining Surveying) Planning and Execution of a Boring Programme; (Parliamentary and General) The New Code of Compensation; Legal Notes; Law Cases; Library Notices; Business Efficiency and Office Management (Recent Residential Course); (Junior Organisation Quarterly) Junior Research Groups; Underground Measuring; and Reasonable Expectations—A Challenge to Junior Surveyors.

From the above it can be readily seen that land management and planning and evaluation as well as construction evaluation and estimating come within the scope of the Royal Institution of Chartered Surveyors.

WALTER S. DIX

Congress News

Louisiana Section

The annual dinner meeting of the Louisiana Section was held at the New Orleans Engineers Club on March 2, 1959, with 110 members and guests attending. Earl G. Harrington, Chief Cadastral Engineer, and Earl Thomas, Associate Director, Bureau of Land Management, Washington, D. C., were the guest speakers.

Mr. Harrington and Mr. Thomas outlined the responsibilities and duties of the Bureau of Land Management and described much of the new equipment and the many new techniques employed in carrying out this vital work.

—H. G. SNEED
Section Secretary

GUEST SPEAKERS AND LOUISIANA SECTION OFFICERS AT ANNUAL DINNER MEETING

Front row, left to right: H. G. Sneed, Section Secretary; C. E. Bridges, Chairman; Earl G. Harrington and Earl Thomas, guest speakers; and Martin Standard, former Chairman. *Back row:* R. C. Dayton, 3rd Vice Chairman; H. G. Truelove, Treasurer; Frank Ritchie; and C. H. Fenstermaker, 2nd Vice Chairman.

New Mexico Section

Following a formative meeting, spearheaded by ACSM President Bestor, at Albuquerque, New Mexico, May 14, 1959, some twenty-one ACSM members from that area formally petitioned for permission to organize the New Mexico Section of the ACSM. The Board of Direction officially approved this petition at its meeting of May 16, 1959, in Washington, D. C. President Bestor has announced the appointment of D. R. W. Wager-Smith, 531 Hermosa Drive, N. E., Albuquerque, as Chairman pro tempore of the new Section, with E. K. Elder, P. O. Box 418, Albuquerque, as Secretary.

Northern California Section

The June meeting of the Northern California Section of the American Congress on Surveying and Mapping was held jointly with the Northern California Section of the American Society of Photogrammetry on June 12, 1959, at the Base Yard of the Corps of Engineers, Sausalito, Calif.

The meeting was called to order by Chairman William Angeloni who then introduced the first speaker, Eugene Huggins, Technical Liaison Officer, U. S. Army Engineers District, San Francisco. Mr. Huggins presented the history, background, progress, and objectives of the San Francisco Bay comprehensive survey being made by the Engineers District. He described the recently completed San Francisco Bay Model and its use in the study. The next speaker introduced by Chairman Angeloni was Donald C. Johnson, Chief of the Foundations and Materials Branch of the District. With the aid of very comprehensive charts and diagrams, Mr. Johnson explained the problems encountered in the design of the Bay Model and the salt water barriers proposed to be constructed in the Bay. The Bay Model, at the horizontal scale of 1 foot equals 1,000 feet and the vertical scale of 1 foot equals 100 feet, and with overall dimensions of 340 feet by 340 feet, is housed in a warehouse built on bay mud and consequently is settling at a considerably faster rate than is permissible. Screw jacks at the corners of the 5-ton precast concrete floor slabs make it possible to level the entire model.

Chairman Angeloni, acting in his capacity as Chief of the Survey Branch, next explained the surveying involved in the construction of the Bay Model and the work necessary to relate the data obtained by the Hydrographic Office to the terrain surrounding the Bay. A concept new to most of the members present was the basing of

the bay bottom elevations on the low low water line and not on the mean sea level as is the terrain around the Bay. A series of tide gauges were set up to correlate the low low water level to mean sea level before the Bay bottom elevations could be used for model construction. The various control points on the model were based on the California Grid System, thus making the layout comparatively simple.

A very interesting film was shown dealing with the models constructed and tested by the Corps of Engineers at the Vicksburg, Miss., office. The work done with the models and the resulting works built from information gathered from the models was a fascinating subject to the more than one hundred members and guests present.

A tour of the model, conducted by Wardel D. Johnston, Jr., Hydraulic Engineer, San Francisco Bay Section, assisted by Mr. Long of his office, topped the very interesting evening. The action of the tide and the mixing of the salt and fresh waters, as well as the movement of the water at the change of tides, was amazing. The movement of water in two directions, in and out at the same time, would be hard to believe if it were not made plainly visible by use of dyes at different levels showing water on top moving upstream and water on the bottom moving downstream.

—EDWARD F. KULHAN
Section Editor

St. Louis Section

The St. Louis Section, ACSM, held an outstanding meeting on May 27, 1959, with well over 200 present. Three major attractions consisted of an out-of-doors barbecue and two very capable speakers.

Owen W. Williams of AFCRC presented a paper, "Some Geophysical Programs of Cambridge Research Center," and discussed activities in relation to the International Geophysical Year. This very interesting talk was well illustrated with color slides.

Bela Szabo of ACIC, Research Division, is a geodesist of some repute who was born and educated in Hungary. He discussed "The Growth of Geodesy from Local Surveys to the World Geodetic System." A paper, based on this talk, is being prepared for submission to SURVEYING AND MAPPING for publication.

New officers for the coming year have been elected. They are:

Chairman—Thomas C. Finnie
Vice Chairman—Gordon E. Stine
Directors—Frank A. Clemens (outgoing chairman), William D. Cannell, John Jolley, G. T. Sanders, and L. T. Whisnant.
Secretary—Edward J. Bronczyk
Treasurer—Robert R. Bard
Section Editor—Louis T. Bernero

—SHERIDAN L. HALL
Section Editor

Nominations Committee

ACSM President George C. Bestor has appointed the following recent past presidents to be the current Nominations Committee to select next year's ACSM officers and directors for the official slate. The committee includes: Lester C. Higbee, Robert H. Lyddan, and W. B. Williams, *Chairman.*

20th Annual Meeting

Granville K. Emminizer has been appointed as the ACSM's 20th Annual Meeting Chairman, with John M. McAlinden appointed his Deputy on Program. Plans are already under way for the 1960 ACSM–ASP Convention which is scheduled for March 20–26, 1960.

OFFICERS AND DIRECTORS, ST. LOUIS SECTION, ACSM

Left to right: Wm. D. Cannell, *Director;* L. T. Whisnant, *Director;* G. T. Sanders, *Director;* Thomas C. Finnie, *Chairman;* Gordon E. Stine, *Vice Chairman;* John Jolley, *Director;* and Frank A. Clemens, *Past Chairman* and *Director.*

Professional Status Committee

The "core committee" of the ACSM Professional Status Committee, consisting of Chairman Lester C. Higbee, Secretary Howard Teas, and Victor H. Ghent, met with Brother B. Austin Barry, F.S.C., in New York City, on July 10–11, 1959, to review data on the ASCE "Status of Surveying and Mapping" study. The committee drafted its proposed modification of the "classification chart" as a basis for intelligent further study. The "core committee" was scheduled to meet again in the latter part of August, just prior to Chairman Higbee's departure for International meetings in Europe, including the Krakow, Poland, assembly of the Federation Internationale des Geometres, September 4–7, where the ACSM delegates will meet.

Control Surveys Division

The Control Surveys Division of the American Congress on Surveying and Mapping has announced the election or the appointment of the following to serve for the 1959–60 term, except as otherwise noted.

Directors:

R. G. Watts—*Chairman 1960 Meeting*—Chief Civil Engineer, Magnolia Petroleum Company, P. O. Box 900, Dallas 21, Texas

Lt. Cmdr. Daniel E. Whelan—*Chairman 1961 Meeting*—Dean of Engineering, Loyola University, Los Angeles, California

Julius L. Speert—*Chairman 1962 Meeting*—U. S. Geological Survey, Washington 25, D. C.

Secretary—James B. Small, U. S. Coast and Geodetic Survey, Washington 25, D. C.

Membership Committee—Emery T. Snyder, *Chairman,* Army Map Service, 6500 Brooks Lane, Washington 25, D. C.

Research and Development Committee—James Buckmaster, *Chairman,* Research Specialist, U. S. Geological Survey, Washington 25, D. C.

Technical Standards Committee—Charles A. Whitten, *Chairman,* Chief, Triangulation Branch, Geodesy Division, U. S. Coast and Geodetic Survey, Washington 25, D. C.

Public Education Committee—Prof. Arthur J. McNair, *Chairman,* School of Civil Engineering, Cornell University, Ithaca, N. Y.

Nominating Committee—E. D. Morse, *Chairman,* Houston Light and Power Company, P. O. Box 1700, Houston 1, Texas. The other members of this committee are: Benjamin E. Beavin, Sr., and Capt. Albert J. Hoskinson.

Program Committee—James B. Small, *Chairman,* U. S. Coast and Geodetic Survey, Washington 25, D. C. The other members of this committee are: Homer Fuller and Julius L. Speert.

Representative on Publications Committee—H. P. Kaufman, U. S. Coast and Geodetic Survey, Washington 25, D. C.

Representative on Professional Status Committee—Capt. Albert J. Hoskinson, U. S. Coast and Geodetic Survey (Retired), home address; 4402 Fessenden St., N.W., Washington 16, D. C.

More "Congress News" on page 430.

Personals

Milton O. Schmidt, Professor of Civil Engineering, University of Illinois, is spending the period of his sabbatical leave, September 1959 to August 1960, in study at the Swiss Polytechnic Institute in Zurich, Switzerland, under a Science Faculty Fellowship from the National Science Foundation.

Colonel **F. O. Diercks** remains at Army Map Service, Corps of Engineers, U. S. A., as its Commanding Officer, despite recent published reports that he was leaving for a post at Fort Bragg. Orders leading to the previous news releases were rescinded.

Captain **I. E. Rittenburg,** Assistant Director for Administration, Coast and Geodetic Survey, since 1952, and a Director of ACSM in 1957 and 1958, retired from the Survey on July 31, 1959, after thirty-six years service.

ACSM Director **William C. Cude** has received an award for "Sustained Superior Performance" of his duties from the U. S. Army Engineer Research and Development Laboratories, Ft. Belvoir, Va.

Dr. **Burton W. Adkinson,** Head of the Office of Science Information Service, National Science Foundation, was installed as the 1959–1960 President of the Special Libraries Association at its annual business meeting held June 3, 1959, at Atlantic City, New Jersey, where the association celebrated its fiftieth anniversary.

Dr. Adkinson began his special library career as an Associate Regional Assistant in the State Department's Office of Geography, then served as Assistant Director of the U. S. Board on Geographic Names and Assistant Chief of the Map Intelligence Section of the Office of

Strategic Services. In 1945 he became Assistant Chief of the Map Division of the Library of Congress, the beginning of a twelve-year association in which he was progressively Acting Chief, then Chief of the Map Division, and then Head of the Reference Department. He has been Head of the National Science Foundation's Science Information Service since 1957.

Porter W. McDonald, Jr., has left his position as Instructor in Civil Engineering, Case Institute of Technology, Cleveland, Ohio, to become Product Manager, Civil Engineering Instruments, for the Eugene Dietzgen Co., Chicago, Ill.

Deaths

Ever since the inception of the American Congress on Surveying and Mapping, the flag decorations for its annual meetings have been under the personal care of Brooks B. Harding of the United Nations Honor Flag Committee who in 1942 designed the "International Good Will Flag," a flag of white background and four red bars representing the "Four Freedoms," free from traditional emotions attached to national flags.

Founder of the Flag Library of the United States, Inc., which supported his dedicated work, Brooks Harding has promoted international good will through flags for the past 16 years.

His name will be missed from future ACSM and ACSM-ASP annual conventions, where it has regularly appeared, because on June 5, 1959, Brooks Harding, 62, died from cancer.

He was a native of Humboldt, Nebraska, attended the University Nebraska, and served as a lieutenant in World War I. Buried in Arlington National Cemetery, he will be remembered wherever free flags wave.

Vernon D. George died Monday, August 3, 1959, at the George Washington University Hospital in Washington, D. C., at the age of 61.

A civil engineer and surveyor, he was vice president and treasurer of the surveying firm of Seybolt and George, Inc., of Silver Spring, Md.

He was well known to members of the Property Surveys Division of the ACSM, many of whom visited him at the hospital during convention several years ago, when he underwent surgery at that time. He was recovering from another operation when death occurred.

Mr. George was vice chairman of the Property Surveys Division in 1956 and was very active in Division affairs. He headed the committee on Professional Land Surveyors Liability Insurance studies, which activity he carried on vigorously until illness in the past few years required him to pass the work on to others. The work has been continued, and the questionnaire announced on page 354 of this issue of SURVEYING AND MAPPING is a continuation of the committee effort under his leadership.

He was a native of Bayonne, N. J., a graduate of a Woodstock, Pa., high school, and attended West Chester State Teachers College. He came to Washington some forty years ago and was employed as deputy chief survey engineer for the Washington Suburban Sanitary Commission. For the past eighteen years he has been in private practice with Seybolt and George, Inc.

Mr. George was a member of the American Association of Engineers, American Geophysical Union, Prince Georges-Montgomery Engineering Society, Silver Spring Rotary Club, and the Washington Association of Credit Men, as well as the ACSM.

Interment in Lancaster, Pa.

William G. Van Cleve, 55, a Registered Land Surveyor and former County Surveyor for St. Charles County, Mo., died in the early morning of June 14, 1959, following a heart attack. He had been under the care of his physician for nearly two years.

Mr. Van Cleve, in addition to his membership in ACSM, was a member of the Society of Professional Engineers, Society of American Military Engineers, Missouri Real Estate Brokers Association, Loyal Order of Moose, and Fraternal Order of the Eagles.

He is survived by his wife, Lois; a son, William G., Jr.; two married daughters; five grandchildren; his mother, two sisters, and a brother.

George M. Houck, SURVEYING AND MAPPING's contact man at Business Press Inc., Lancaster, Pa., retired from active duty with that organization in August. I am sure that the two previous editors of this Journal, A. L. Shalowitz and Robert C. Eller, will join me heartily in wishing Mr. Houck many happy and pleasant years of freedom from the worries and troubles of keeping us amateur editors on an even keel.

—HOWARD S. RAPPLEYE

NEW MEMBERS

INDIVIDUAL MEMBERSHIPS

ADAMS, J. L., 674 Clermont St., Denver 20, Colo.—Consulting Engineer and Land Surveyor

ADKINS, Joe L., Box 2528, Virginia Polytechnic Institute, Blacksburg, Va.—Student

ALLWINE, A. Dillon, c/o The Ruckert Co., 922 Pine St., St. Louis, Mo.—Manager, The Ruckert Co.

AMBURN, Garnett S., Box 190, Route 2, Annandale, Va.—Cartographer, U. S. C. & G. S.

ANAYA, Marvin, City Hall, Pittsburg, Calif.—Deputy City Engineer

ANTILL, Paul A., 2082 S. Paseo Way, Denver 19, Colo.—Topographic Engineer, U. S. G. S.

BAADER, Richard M., 92 Suncrest Drive, Rochester 9, N. Y.—Civil Engineer-Land Surveyor

BALDERSON, Lt. Cdr. James R., Providence Hall, Hague 1, Va.—Surveyor

BARDONNER, Carl E., 2216 Glen Flora Ave., Waukegan, Ill.—Surveyor, James Anderson Co., Inc.

BARNES, Sidney B., Barnes & Holden, Inc., Box 108, New Castle, Del.—Civil Engineer and Land Surveyor

BARNETT, Ralph E., P. O. Box 412, Augusta, Me.—President, Ralph E. Barnett, Inc.

BAYER, William F., 151 Lynwood Drive, Clearfield, Utah—Supervisory Cartographer, U. S. Forest Service

BEATY, Leslie H., 2289-A 36th St., Los Alamos, N. Mex.—Survey Engineer, The Zia Co.

BENEDUM, Charles L., 8811 Falls Road, Bethesda, Md.—President, Benedum Instrument Co.

BENJAMIN, B. C., 3120 California, N. E., Albuquerque, N. Mex.—Mechanical Engineer, Sandia Corp.

BEYER, C. B., P. O. Box 239, Albuquerque, N. Mex.—Professional Engineer and Land Surveyor, Ross-Beyer Engineering Office

BLAKNEY, Prof. William G. G., Alabama Polytechnic Institute, Auburn, Ala.

BLANCHARD, Fred H., 10666 Ohio Ave., West Los Angeles, Calif.—Field Engineer, Los Angeles County

BLISS, Thomas F., 135 N. Euclid Ave., Westfield, N. J.—Partner, Tectonic Associates

BORGESON, Warren T., P. O. Box 4197, Sacramento 21, Calif.—Topographer, U. S. G. S.

BRADFORD, Haskell E., 1438 N. 9th St., Colton, Calif.—Chief of Party, California Division of Highways

BROWN, Joseph H., 15728 S. Blaine Ave., Bellflower, Calif.—Party Chief, Los Angeles County Engineers

BRUCE, Robert H., P. O. Box 4197, Sacramento 21, Calif.—Civil Engineer, U. S. G. S.

BURCHETT, Harry P., 222 Cowbell Road, Willow Grove, Pa.—Aero Service Corp.

CALLAHAN, John V., 53 S. Broadway, Yonkers, N. Y.—Land Surveyor

CASAS, Sr. Manuel Llanos, 116 Manuel Castaneda, Lima, Peru

CAWTHORNE, J. Dale, 205 Ninth St., N.W., Canton, Ohio—Assistant Planner, Stark County Regional Planning Commission

CEELY, Frederick Floyd, Jr., 1101 Bren Mar Drive, Alexandria, Va.—Mathematician, U. S. C. & G. S.

CHAMBERLAIN, James E., P. O. Box 4197, Sacramento 21, Calif.—Civil Engineer, U. S. G. S.

CLARK, Wilmer F., 2806 Park Ave., Minneapolis 7, Minn.—Engineer, Survey and Plans, City Engineering Dept.

CLAUSER, Richard W., 3301 Harrison Ave., Muhlenberg Park, Reading, Pa.

CLAYTOR, Raymond J., P. O. Box 118, Blue River, Oreg.—Chief of Party, Shaw, Dobyns and Associates

CONDLEY, Clyde, 3253 Elgin Drive, Salt Lake City, Utah—Knight-Condley Reproduction

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Air Photo Repository

A unique Air Photo Repository has been established at University of Illinois to collect, store, and reproduce aerial photographs for teaching and research programs.

Aerial photography in the repository will be useful to other colleges and universities and to State and local governments, conservation districts, and forest units.

The repository will accept vertical and oblique aerial negatives of any part of the world and will hold them subject to recall by the depositing agency. Prints of negatives filed in the repository may be purchased from the University of Illinois Committee on Aerial Photography.

The University also operates its own aircraft and has the equipment and personnel needed to secure its own aerial photography. Thus Illinois can take and process aerial photography needed in many of its teaching and research programs.

The Committee on Aerial Photography was appointed in October 1958, to "advise and serve all departments and offices of the University in matters pertaining to aerial photography." The committee actively encourages research projects which will contribute to improved aerial photography and to improved use of aerial photographs.

A study of light reflectance from forest vegetation is being conducted under a grant from the Office of Naval Research. This work is directed by Dr. Lawrence C. Bliss, Department of Botany, and Charles E. Olson Jr., Department of Forestry.

Studies relating to photogrammetric mapping also are in progress. They are being conducted under direction of Dr. Houssam M. Karara, Department of Civil Engineering.

Coast and Geodetic Survey Aeronautical Charts

The production of aeronautical charts and related publications by the Coast and Geodetic Survey is in accordance with provisions of the Air Commerce Act of 1926, the Civil Aeronautics Act of 1938, and Public Law 373 approved August 6, 1947.

The area of responsibility includes construction and maintenance of aeronautical charts covering the United States and possessions as required for civil aviation and for military use where the requirements are parallel. It also provides for the production of charts required by United States civil aviation for international operations.

The Coast and Geodetic Survey aeronautical charts are constructed with the highest degree of accuracy, utilizing basic field surveys of the Bureau and other agencies and the best available source material in the form of maps, charts, and aerial photographs. The very extensive and complex aeronautical data are compiled and applied in the form of overprints with the same standard of accuracy.

In meeting the Bureau's responsibilities, aeronautical charts are produced at various scales and for different purposes. Some of the series, while designed for air navigation, are used for other purposes. Those coordinated series which are at a uniform scale and provide detaailed terrain and cultural information are particularly popular. For this reason, limited quantities of the Sectional and WAC* series are available without the aeronautical overprint.

The following are brief descriptions of those charts designed for visual or limited visual flight. Charts produced for instrument flight are not included.

The WAC, Sectional, and Local charts of the United States are constructed on the Lambert Conformal Conic Projection with standard parallels at 33° and 45°. The Jet and Route charts are also on the Lambert projection; however, the standard parallels are 37° and 65°. The amount of topographic and cultural detail and extent of aeronautical data vary with the purpose of the charts. All charts are printed in multiple colors in order to separate the various features and provide for maximum clarity.

Sectional Charts

The United States is covered by 87 charts at a scale of 1: 500,000 (1 inch = 8 statute miles). An additional chart at the same scale is published for the Hawaiian Islands. These charts, being on the same standard parallels, may be trimmed and joined to make a large chart of any area in the United States.

Sectional charts are designed for use in visual (contact) flight by aircraft of low to medium speed. For this reason as much topographic and cultural detail are shown as the scale will allow. Particular care is taken to show those items which are prominent and distinctive when viewed from the air.

Aeronautical data, overprinted in two colors, are limited to that normally used in visual flights. A full aeronautical overprint would obscure the detail necessary for this type of flying. All usable airports and sufficient radio and traffic-control data required in visual flight are shown.

Local Charts

Local aeronautical charts are published of highly congested metropolitan areas. Twenty-three charts are now on issue including one covering Puerto Rico and another covering the Island of Oahu. All are at a scale of 1: 250,-000 (1 inch = 4 statute miles) except the latter which is at the scale of 1: 125,000 (1 inch = 2 statute miles).

The large scale of these charts permits showing a greater amount of detail than the sectional charts, and they are excellent for local visual flights. The treatment of information is the same as on the sectional series, except for minor modifications.

World Aeronautical Charts

The WAC series provides worldwide coverage at a scale of 1: 1,000,000 (1 inch = 16 statute miles). The 43 charts covering the United States and the 19 covering Alaska are published by the Coast and Geodetic Survey.

The smaller scale of these charts makes them more suitable than the sectionals or locals for high speed, long-range flights.

Charts covering the United States or Alaska may be joined; however, those of Alaska cannot be joined with those of the United States as they are on different standard parallels.

Jet Navigation and Route Charts

Jet Navigation and Route Charts are at a scale of 1: 2,000,000 (1 inch = 32 statute miles). They are designed for use in long-range, high-altitude, high-speed navigation. The treatment

* World Aeronautical Chart.

of information on the two series is generally the same, the major differences being the layout and coverage.

The Jet Navigation series provides large-area coverage of the world. The four charts of the United States are published by the Coast Survey and those for the rest of the world by the Aeronautical Chart and Information Center of the Air Force.

The Route Charts supplement the Jet series and are in narrow strip form for convenient use in the cockpit. These charts provide route coverage between principal air terminals in the United States. The average width of these charts is about fourteen inches. They vary in length as necessary to provide continuity with other charts of the series.

Two area type Route charts on the Oblique Mercator Projection provide coverage of most of Alaska and tie in with those of the United States. These charts will eventually be converted to the strip-type charts.

Further details concerning these and other charts published by the Coast Survey may be obtained from authorized chart agents located at over 400 airports in the United States, or by writing to the Washington, D. C., office of the Coast and Geodetic Survey.

"Map Library"

Technical Report No. 14, "Map Library," by Bruce Grant, reporting to Chairman Ruben B. Hurd, and dated March 11, 1959, has been published by the East Bay Council on Surveying and Mapping, an affiliate of the ACSM.

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What seems to the writer to be a rather ingenious method of arriving at the hypotenuse of a small right triangle (a traverse closure, when the failures in both x and y are known, for example) was called to our attention last June by Brother B. Austin Barry while at the Manhattan College Camp.

Let a = the hypotenuse and b and c the two legs of the right triangle, Then:

$$a = \sqrt{b^2 + c^2}$$

$$= \frac{b}{b}\sqrt{b^2 + c^2}$$

$$= b\sqrt{\frac{b^2}{b^2} + \frac{c^2}{b^2}}$$

$$= b\sqrt{1 + \frac{c^2}{b^2}}$$

Now try it out with the classical 3, 4, 5 triangle—using your slide rule. Let $c = 3$ and $b = 4$. Using the C and D scales divide 3 by 4; result 0.75. Set the runner at this value on the D scale and read 0.56 on the A scale. Set the runner to 1.56 on the A scale, go back to the D scale, and multiply by 4. Result 5.00 as it should be.

—EDITOR

Research in Surveying at E. R. D. L.

The Surveying and Geodesy Branch at the U. S. Army Engineer Research and Development Laboratories has been testing during the past summer their most recent developments in equipments and techniques for rapid extension of survey control. Emphasis has been placed on the military advantages of automatic systems of equipments for establishing survey control in support of artillery operations.

In addition to recently adopted equipments (but still new to many civil surveyors) such as the tellurometers and geodimeters for distance measurement and an orienting device for establishing an azimuth, several heretofore untried systems were to be tested and evaluated. An automatic position equipment is designed to determine an astronomic position by stellar observations. In this system, a companion electronic computer controls and directs the observation sequence of the automatic observation component and computes the ground position based on star transit data as related to time and altitude.

Another system tested over short ranges is an electronic positioning equipment of the hyperbolic phase comparison type. This equipment will establish control at remote locations as related to transmitters located at established control.

For the extension of control over longer ranges a system of automatic tracking theodolites was tried. These electronic-optical equipments "bridge" control via intermediate flares or airborne lights similar to conventional flare triangulation techniques. Each theodolite automatically tracks the flare or light and "reports" its horizontal and vertical circle readings to a central computer control station. The computer in turn derives the positions of the theodolites on the "unknown stations."

Another system for long range extension of control utilizes airborne electronic equipment. By precise distance measurement, control is extended to stations approximately 150 miles distant by measuring the distance from known control to the aircraft—thence to the "unknown" stations. The data are reduced in the aircraft and relayed to any survey control center.

All the above systems and techniques embrace either applications or principles never before utilized in survey operations and are indicative of the Army Engineers' research and development programs designed to keep pace with the latest concepts of military operations.

Surveying and Mapping Conference

A Surveying and Mapping Conference presented by the School of Civil Engineering and the Division of Engineering and Industrial Extension, Oklahoma State University, in cooperation with the Colorado Sections of the American Congress on Surveying and Mapping and the American Society of Photogrammetry was held at Camp Benham, near Buena Vista, Colo., June 15–16, 1959, with Prof. R. P. Witt in the role of Conference Director.

The morning session on June 15, 1959, featured a talk on "Basic Control for Surveying and Mapping," by Commander William C. Russell, U. S. Coast and Geodetic Survey. The afternoon session presented two papers: "Mapping Methods of the Topographic Division of the U. S. Geological Survey," by Harold F. Johnson, U. S. Geological Survey; and "Aerial Photography and Topographic Mapping Applied to Engineering," by Charles G. Grosvenor, Falcon Air Maps Company, Denver, Colo.

The morning session on the 16th included two papers: "Tellurometer System," by Floyd W. Hough, Vice President, Tellurometer, Inc., Washington, D. C.; and "The Tellurometer and Control Surveys Today," by Robert F. Thurrell, Vice President, Global Exploration Company, Denver, Colo.

In the afternoon a field demonstration of the use of the Tellurometer was staged by Robert F. Thurrell and Albert Danish, Geophysical Instrument Company, Denver, Colo.

The dinner was held during the evening of the 15th. The speaker was Stanley M. Borrell, Chairman, Colorado Section, ACSM, and his subject was "Present Status and History of Surveying and Mapping."

An outstanding feature of the conference was the informal atmosphere which prevailed. The beautiful surroundings and the southern hospitality extended by Professor Witt and his colleagues made the meeting a thing to long remember. The conference was attended by fifty-five engineers and land surveyors from seven different States, in addition to the thirty-five students attending the summer camp.

On behalf of the Colorado Section, ACSM, I would like to thank Professor Witt for asking us to cosponsor his conference. I am certain that everyone in attendance enjoyed themselves and will be looking forward to another similar meeting.

—STANLEY M. BORRELL
Chairman, Colorado Section, ACSM

Land Surveyor Course

Sponsored by the Department of Civil Engineering of the University of Florida and the Florida Society of Professional Land Surveyors, a "Land Surveyors Course" was held at Gainesville, Florida, June 1–5, 1959, with 25 registered students attending.

The program for the course included both morning and afternoon sessions of three hours each on each of the five days devoted to the course.

The subjects covered included Land Boundary Descriptions, Technical Standards, Judicial Functions and Ethics (two sessions), Survey Maps and Plans, Excess and Deficiency, Unusual Problems in Subdivision of Sections, Evidence of Location of Corners and Lines Other Than Government, and Riparian Rights in Florida, with the last afternoon session being devoted to a Summation and the presentation of certificates.

That the course proved to be a successful one is evidenced by the following letter, written to Professors Sumner B. Irish, Harmer A. Weeden, Francis H. Moffitt, Brother B. Austin Barry, and Messrs. Sol A. Bauer and Walter S. Dix.

Gentlemen:

Almost three years ago I wrote to all of you requesting assistance and information to enable me to present a case urging the formation of an extension course for Land Surveyors in the State of Florida.

The attached program is for the first presentation of such a course, and is evidence of the accomplished fact.

We consider our first course a success as: (1) not one of the twenty-five paid customers went to sleep and; (2) we had several requests for us to repeat the same course—"Because there was so much that we couldn't assimilate it all."

Furthermore, we received applications for membership in the Florida Society of Professional Land Surveyors for most of the non-members attending.

I wish to convey to each of you the "rising vote of thanks and appreciation" from the students to all concerned with the organization and presentation of the course, as well as my own personal appreciation for your accomplishments on the behalf of all Land Surveyors.

Bill Wattles is not being forgotten as I am writing him a more personal letter which will add to the voluminous correspondence in which he and I have been engaged.

Very truly yours
HUGH A. BINYON
Vice President, FSPLS

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See notice concerning
1960 Meetings and Exhibits
(Page 432)
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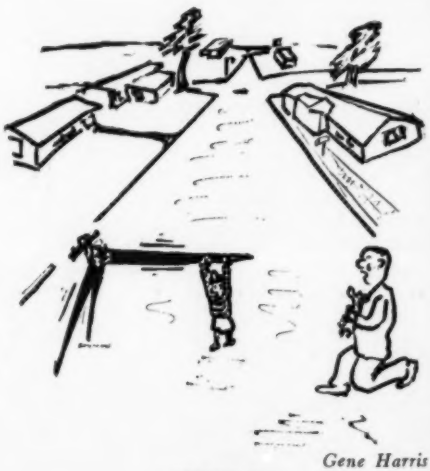

Gene Harris

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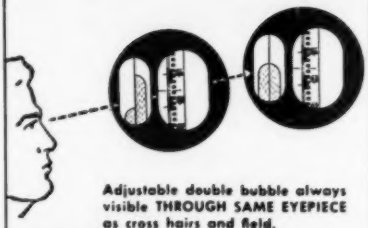

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Now Hear This

Venus Pen and Pencil Corporation has recently brought out a series of color pencils—five colors—under the name "Col-Erase" which make marks which are as easily erased as those made with ordinary black lead pencils. We were given a sample of the "116 Carmine Red," and found it to be "just what the doctor ordered" for marking copy.

The Fennel Instrument Corporation of America has recently announced a new theodolite, the "Sethe," which reads to directly to single seconds on both the horizontal and vertical circles. These "one second jobs" are getting to be common as grass, and if we could only point 'em as accurately as we can read 'em we might get better results.

Keuffel & Esser has introduced a series of "Tear Drop" curves which should be as useful for short radius work in the design of highway interchanges as the old sets of "railroad curves" were in the heyday of railroad construction.

Even the trifocal spectacles which the editor wears did not keep him from making a mistake on page 298 of the June 1959 issue of SURVEYING AND MAPPING. In the second line of the "editor's note" the organization named should have been the North American *Precis* Syndicate, Inc.

The National Capital Section of the American Society of Civil Engineers distributed in August 1959 a printed, ten-page, 3½- by 8-inch pamphlet entitled "A New Day in Engineering Education," by Brother B. Austin Barry, F.S.C., of the Civil Engineering Department at Manhattan College. This is Brother Austin's address at the Annual Dinner of the NCS-ASCE, March 10, 1959, which was held at the Shoreham Hotel in Washington, D. C., during the ACSM Annual Convention. This pamphlet is recommended good reading for those who wish to understand the current thinking in upper educational circles regarding engineering education.

The August 1959 issue of *The Civil Engineer*, the newsletter of the National Capital Section, American Society of Civil Engineers, suggests that members visit George Washington's boyhood home at Ferry Farm, Fredericksburg, Virginia, where his first survey office is located. This office has been restored. It might be a very interesting place for ACSM members to visit, especially when it is remembered that George Washington was the first licensed surveyor in what is now the United States.

Six New Charts in Intracoastal Waterway Series

Six new charts have been added to the Intracoastal Waterway series, extending the coverage to include the Florida Keys to Key West.

The new additions, printed back to back at a scale of 1:40,000, include the first editions of 849–850, Elliott Key to Matecumbe; 851–852, Matecumbe to Bahia Honda Key; and 853–854, Bahia Honda Key to Key West. Chart 859, Big Spanish Channel to Johnston Key, has no back-up and chart 849 was formerly published as a back-up on chart 3261 which is cancelled by the six new additions.

ACSM Member to National Research Council

ACSM past president Robert H. Lyddan has been appointed by President Detlev W. Bronk of the National Academy of Sciences to be a member of the National Research Council, to represent the American Congress on Surveying and Mapping in the Division of Earth Sciences, for the period of three years beginning July 1, 1959. This will be Representative Lyddan's second term to NAS–NRC for ACSM.

Previous ACSM representation to the National Research Council has been: Charles H. Davey, 1950–53; H. Arnold Karo, 1953–56; and Robert H. Lyddan, 1956–59. ACSM became a constituent member of the Division of Earth Sciences of the National Research Council of the National Academy of Sciences in 1950.

Topography Division

A meeting of the Directors of the Topography Division, ACSM, was held on the third floor of the Old Dominion Building, 1109 North Highland Street, Arlington, Virginia, on July 30, 1959.

The Directors of the Division are:

C. W. Buckey, *Chairman*
Charles A. Andregg
C. E. Kowalczyk
E. J. Thatcher

New appointed officers were announced as follows:

C. V. Eckhardt, *Secretary-Treasurer*
E. Swasey, *Associate Editor*

Francis L. Witkege is the Division's representative to the ACSM Professional Status Committee.

C. E. Kowalczyk was named chairman of the Division's nominating committee. The Division ballot is scheduled by December.

Program matters for the coming 1960 Convention and ACSM annual nominations matters were discussed.

Louisiana Section

The regular quarterly meeting of the Louisiana Section, American Congress on Surveying and Mapping, was held Tuesday evening, August 11, 1959, in the Engineers Club of the DeSoto Hotel, New Orleans, Louisiana.

After a social hour, a short business session was presided over by Chairman Robert C. Dayton. Chairman Dayton then introduced representatives of the firm of Gandolfo, Kuhn and Walker, Surveyors, who presented a program consisting of a film, discussion, and demonstration of the Tellurometer and its application in the surveying field.

The meeting was attended and enjoyed by sixty members and guests.

R. S. Burnside, Jr.
Section Editor

The Society of Motion Picture and Television Engineers will hold its 86th semiannual convention at the Statler Hilton Hotel in New York City October 5–9, 1959, with the theme "Motion Pictures and Television in the Space Age." Sessions on Space Technology and Image Sensing will tend to emphasize the application of cinematography and television to rocket and space-vehicle research, including both external observations of vehicles in flight and observations from the vehicles themselves.

The third annual meeting of the Missouri Association of Registered Land Surveyors is to be held October 3, 1959, at the Hotel Missouri in Jefferson City, Mo.

The Eighth Annual Texas Surveyors Association Short Course is sheduled for October 5–7, 1959, at the Stephen F. Austin Hotel in Austin, Texas.

APPLICATION FOR MEMBERSHIP

I am interested in surveying and mapping and hereby apply for membership in the American Congress on Surveying and Mapping. I enclose $5.00 (U. S. and Possessions), $6.00 (Foreign) in payment of annual dues.

Name (Please type or print) .....

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Mailing Address .....

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Occupation and Organization .....

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Branches of surveying and mapping preferred .....

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Reference. If registered, please indicate .....

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Applicant's Signature ..... Date .....

(Send to: Chairman, Membership Committee, 905 Washington Bldg., 1435 G St., N.W., Washington 5, D. C.)

Reprints of Articles

Reprints in quantities of 50 or more may be obtained of any article appearing in this issue. Orders must be placed with the Editor-in-Chief, Howard S. Rappleye, 6712 4th St., N.W., Washington 12, D. C., not later than 3 weeks after publication. Authors who wish reprints of their articles may so indicate when manuscripts are submitted. Approximate prices of reprints follow:

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1960 ACSM & ASP Convention
Consecutive Meetings and Co-Exhibits

ACSM Twentieth Annual Meeting—March 20, 21, 22, 23
ASP Twenty-sixth Annual Meeting—March 23, 24, 25, 26
Exhibits—March 22, 23, 24

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If you were not among the many who enjoyed the passing year's meetings of the American Congress on Surveying and Mapping and the American Society of Photogrammetry, don't let it happen to you next year!

Start making your plans now to attend and take advantage of the valuable Technical and Professional Sessions and the Exhibits already being arranged by convention and program chairmen under coordination of your Convention Director, Mr. Thomas A. Hughes.

Meet old friends and new from all over the World, who gather each year to inform and keep informed on New Developments in their various fields.

DON'T FORGET—MARK YOUR CALENDAR NOW!!

VANCE A. ROGERS, *Chairman*
1960 ACSM-ASP Publicity Committee

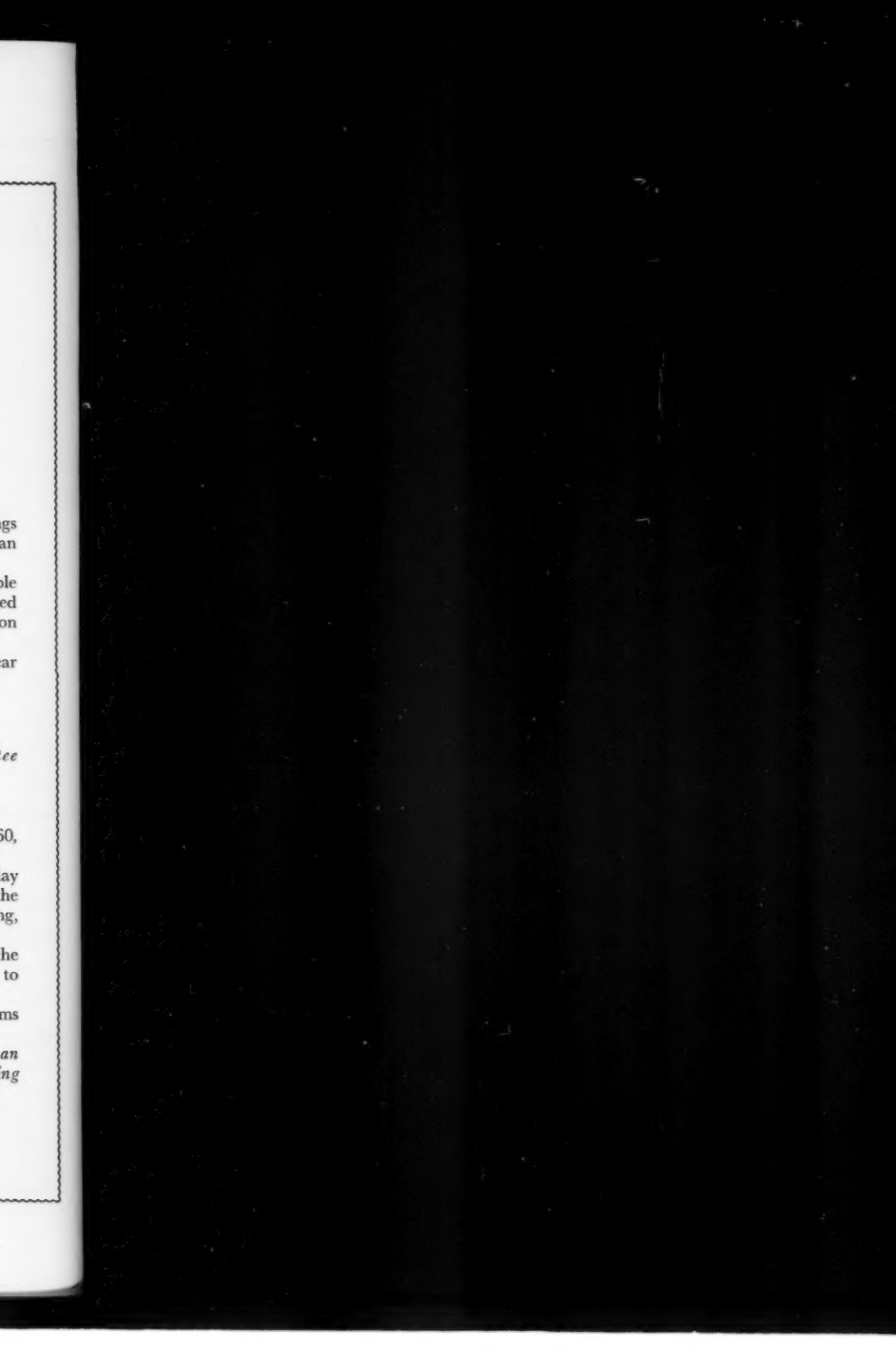
Notice—to ACSM Members and Officers:

The ACSM Twentieth Annual Meeting opens on Monday, March 21, 1960, and continues until noon on Wednesday, March 23, 1960.

All Divisions should attempt to schedule their business meetings for Monday morning, at which time they can finalize any items for presentation to the ACSM Annual Business Meeting, which is scheduled for Tuesday evening, March 22, 1960.

Members who were present at the 19th Annual Meeting can attest to the huge success experienced by our organization and should lay plans now to attend the 1960 Convention *and bring other members.*

Divisions are requested to make their plans and shape their programs accordingly.

G. K. EMMINIZER, JR., *Chairman*
ACSM Twentieth Annual Meeting

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